DAFTAR REVISI

NO	HAL	TERTULIS	SEHARUSNYA
1.	1 dst	Istilah asing dicetak tegak	*Dicetak miring*
2.	4 dst	Penulisan ket.gambar salah	Ditulis sesuai acuan
3.	19	Penulisan ket.tabel salah	Ditulis sesuai acuan
4.	20	Idem	Idem
5.	10 dst	Kata dimana	Diganti sesuai konteks kalimat
6.	1	Teknik	Metoda geofisika
7.	2	Manfaat yang lebih	Kelebihan
8.	5	Gelombang bidang	Gelombang datar
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10.	19	Direri nomor	Diberi nomor
11.	26	Pengolahan data	Pengambilan data
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13.	Lamp.A	Ket.nomor rumus (A.1)dst (B.1)dst (C.1)dst (D.1)dst	(A.1.1)dst (A.2.1)dst (A.3.1)dst (A.4.1)dst

Semarang, 16 Februari 1999

Panitia Penguji Ujian Sarjana

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LAMPIRAN A

A. IMPEDANSI MEDIUM HOMOGEN ISOTROPIS

Untuk mendapatkan formula resistivitas semu dan impedansi pada medium homogen isotropis, maka kita harus menentukan dulu konstanta-konstanta (E_0^-,E_1^+) dengan menerapkan syarat batas yaitu E_x dan H_y harus kontinyu pada bidang batas. Masukkan persamaan (2.29) ke (2.27) dan (2.28) sehingga akan memberikan medan-medan magnetik:

$$H_y^0 = \frac{E_0^+}{\eta_0} e^{-ik_0 z} - \frac{E_0^+}{\eta_0} e^{-ik_0 z} \qquad \text{(A.1.1)}$$

$$H_y^1 = \frac{E_1^+}{\eta_1} e^{-ik_1 z} \qquad \text{(A.1.2)}$$

dengan η_0 dan η_1 adalah impedansi antara udara dan bumi:

$$\eta_0 = \frac{i\omega\mu_0}{ik_0} = \left[\frac{\mu_0}{\varepsilon_0}\right]^{1/2}$$

$$\eta_1 = \frac{i\omega\mu_0}{ik_1} = \left(\omega\mu_0\rho\right)^{1/2} e^{i\frac{\pi}{4}}$$

Dengan menyamakan komponen tangensial dari E dan H pada Z=0, akan menghasilkan:

$$E_1^+ = E_0^+ + E_0^-$$

$$\frac{E_1^+}{\eta_1} = \frac{E_0^+}{\eta_0} - \frac{E_0^-}{\eta_0}$$

Solusi dari sistem persamaan diatas adalah:

$$E_1^+ = \frac{2\eta_1}{\eta_0 + \eta_1} E_0^+ \qquad \text{(amplitudo gel. transmisi)} \qquad \text{(A.1.3)}$$

$$E_0^1 = \frac{\eta_1 - \eta_0}{\eta_0 + \eta_1} E_0^+ \qquad \text{(amplitudo gel. refleksi)} \qquad \text{(A.1.4)}$$

Akhirnya diperoleh medan listrik dan medan magnet adalah :

diudara:

$$E_x^1 = E_0^+ \left[e^{-ik_0 z} + \frac{\eta_1 - \eta_0}{\eta_1 + \eta_0} e^{ik_0 z} \right] \qquad \text{(A.1.5)}$$

$$H_y^1 = \frac{E_0^+}{\eta_0} \left[e^{-ik_0 z} - \frac{\eta_1 - \eta_0}{\eta_1 + \eta_0} e^{ik_0 z} \right] \qquad \text{(A.1.6)}$$

dibumi:

$$E_x^1 = \frac{2\eta_1}{\eta_0 + \eta_1} E_0^+ . e^{-ik_1 z} \qquad \text{(A.1.7)}$$

$$H_y^1 = \frac{2\eta_1}{\eta_0 + \eta_1} E_0^+ . e^{-ik_1 z} \qquad \text{(A.1.8)}$$

Pada permukaan bumi (Z=0), persamaan diatas akan berlaku sama. Perbandingan antara E_x/H_y pada permukaan disebut sebagai impedansi permukaan Z. Untuk bumi homogen impedansinya adalah:

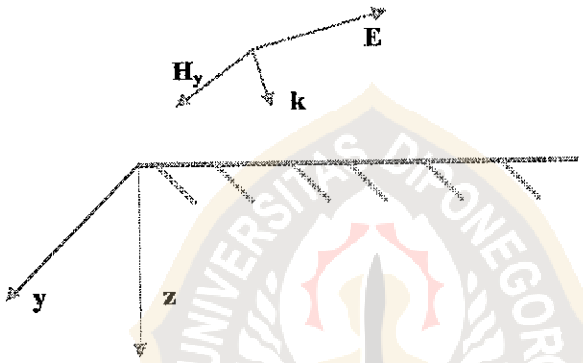
$$Z = \frac{E_x}{H_y} = \frac{\dfrac{-2\eta_1}{\eta_0 + \eta_1}}{\dfrac{2}{\eta_0 + \eta_1}} = \eta_1 = (\omega \mu_0 \rho)^{1/2} e^{i\frac{\pi}{4}} \qquad \text{(A.1.9)}$$

B. PENURUNAN IMPEDANSI LAPISAN N

Untuk menentukan impedansi dalam model TM dan TE, maka digunakan asumsi dimana sudut datang gelombang bidang sembarang. Kita akan bahas mode TM dan TE secara terpisah.

a. Mode TM

Dalam gambar dibawah ini, dimana diturunkan mode TM, maka kita mempunyai komponen-komponen E_x,E_z,dan H_y, yang semuanya bervariasi dalam arah x dan z.



Gelombang datang yang dapat dituliskan dalam:

$$\overline{H} = H_y^0 e^{-i\overline{kr}}\,\hat{y} \qquad \text{(A.2.1)}$$

dimana y adalah vektor unit dalam arah y.

Gelombang bidang yang menjalar dalam arah z akan mempunyai komponen-komponen E_x dan H_y, dan karena:

$$\nabla^2\overline{E} = \nabla^2 E_x\hat{x} + \nabla^2 E_y\hat{y} + \nabla^2 E_z\hat{z} \qquad \text{(A.2.2)}$$

maka persamaan (2.16) akan menjadi:

$$\nabla^2 E_x + k^2 E_x = 0$$

karena : $$\nabla^2 E_x = \frac{\partial^2 E_x}{\partial x^2} + \frac{\partial^2 E_y}{\partial y^2} + \frac{\partial^2 E_z}{\partial z^2} \qquad \text{(A.2.3)}$$

dan E_x tidak berubah dalam arah x dan y, maka kita akan mendapatkan persamaan diferensial:

$$\frac{d^2 E_x}{dz^2} + k^2 E_x = 0 \qquad \text{(A.2.4)}$$

Dengan cara yang sama seperti halnya di atas, maka kita dapatkan juga untuk H_y:

$$\frac{\partial^2 H_y}{\partial x^2} + \frac{\partial^2 H_y}{\partial z^2} + k^2 H_y = 0 \qquad \text{(A.2.5)}$$

didapatkan :

$$H_y = \left[H^+ e^{-uz} + H^- e^{uz}\right] e^{-\lambda z} \qquad \text{(A.2.6)}$$

Gelombang dapat berpropagasi ke arah atas dan bawah, tetapi selalu dalam arah x positif, sehingga hubungan parameter u dan l dapat dituliskan sebagai:

$$u = (\lambda^2 - k^2)^{1/2} \qquad \text{(A.2.7)}$$

kita dapat menuliskan gelombang datang sebagai:

$$H_0^+ e^{-uz} e^{-i\lambda x} = H_0 e^{-i\vec{k}\vec{r}} - H_0 e^{-ik_0(\cos\theta)z} e^{-ik_0(\sin\theta)x} \qquad \text{(A.2.8)}$$

kita definisikan:

$$\lambda = k_0 \sin\theta = k\,x$$

$$u = ik_0 \cos\theta = ik_0$$

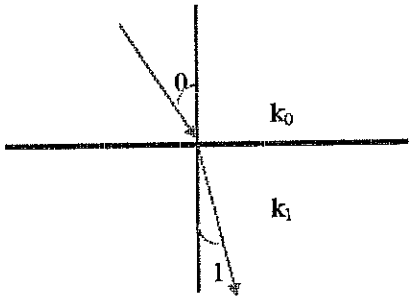
dimana $k_o \cos\theta$ konstanta propagasi dalam arah z, dan $k_o \sin\theta$ merupakan konstanta propagasi dalam arah x.

Untuk memecahkan medan medan tersebut, diambil gelombang datangdalam arah vertikal, sehingga:

$\lambda_0 = k_0 \sin\theta_0$ untuk di udara

$\lambda_1 = k_1 \sin\theta_1$ untuk di bumi

Untuk syarat batas, maka medan harus kontinyu pada bidang batas.



$$\lambda_0 = \lambda_1$$

$$k_o \sin\theta_0 = k_1 \sin\theta_1 \qquad \text{(A.2.9)}$$

$$\sin\theta = \frac{k_0}{k_1} \sin\theta$$

Persamaan diatas merupakan hukum Snellius, dan karena k1>>k0 maka gelombang akan berpropagasi secara vertikal kebumi dengan sudut tertentu.Sebagai syarat batas, dimana 1 harus sama untuk kedua sisi bidang batas, maka persamaan (A.2.5) hanya perlu ditinjau dalam arah z. Medan magnetik akan menjadi:

di udara: $H_y^0 = H_0^+ e^{-u_0 z} + H_0^- e^{u_0 z}$ (A.2.10)

di bumi: $H_y^1 = H_1^+ e^{-u_1 z}$ (A.2.11)

dengan :

$$u_0 = (\lambda^2 - k_0^2)^{1/2}$$

$$u_1 = (\lambda^2 - k_1^2)^{1/2}$$

Medan listrik horisontal E_x dapat ditentukan dengan menggunakan hukum Ampere:

$$E_x = \frac{1}{\sigma + i\omega\varepsilon}\frac{\partial H_y}{\partial z} \qquad \text{(A.2.12)}$$

Dengan mensubstitusikan (A.2.10) dan (A.2.11) kedalam (A.2.12), menghasilkan:

$$E_x^0 = K_0 H_0^+ e^{-u_0 z} - K_0 H_0^- e^{u_0 z} \qquad \text{(A.2.13)}$$

$$E_x^0 = K_1 H_1^+ e^{-u_0 z} \qquad \text{(A.2.14)}$$

dimana:

$$K_0 = \frac{u_0}{i\omega\varepsilon_0} \quad \text{dan} \quad K_1 = \frac{u_2}{\sigma_1}$$

Persamaan tangensial E dan H pada z=0, didapatkan:

$$H_1^+ = H_0^+ + H_0^- \qquad \text{(A.2.15)}$$

$$K_1 H_1^+ = K_0 H_0^+ - K_0 H_0^- \qquad \text{(A.2.16)}$$

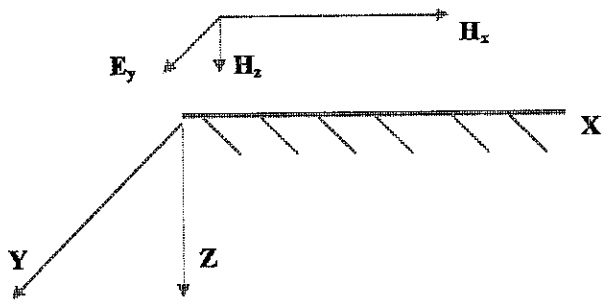
Dengan memecahkan dua persamaan diatas, maka kita dapatkan:

$$H_1^+ = \frac{2K_0}{K_0 + K_1} H_0^+ \quad \text{(gel. transmisi)} \qquad \text{(A.2.17)}$$

$$H_0^+ = \frac{K_0 - K_1}{K_0 + K_1} H_0^+ \quad \text{(gel. refleksi)} \qquad \text{(A.2.18)}$$

b. Mode TE

Dalam kasus mode TE komponen-komponennya meliputi E_y,H_x, dan H_z.



Dengan cara yang sama seperti pada mode TM, didapatkan solusi umum untuk E_y adalah:

$$E_y = [\, E^+ e^{-uz} + E^- e^{uz} \,] e^{-kx} \qquad \text{(A.2.19)}$$

seperti halnya syarat batas sebelunya, dimana medium homogen dalam arah horizontal, maka kita hanya meninjau solusi untuk arah z yaitu:

diudara: $$E_y^0 = E_0^+ e^{-u_0 z} + E_0^- e^{u_0 z} \qquad \text{(A.2.20)}$$

dibumi: $$E_y^1 = E_1^+ e^{-u_1 x} \qquad \text{(A.2.21)}$$

Medan magnet horisontal H_x dapat ditentukan dengan menggunakan hukum Faraday:

$$H_x = \frac{1}{i\omega\mu_0} \frac{\partial E_y}{\partial z} \qquad \text{(A.2.22)}$$

Dengan mensubstitusikan (A.2.20) dan (A.2.21) kedalam (A.2.22), menghasilkan:

$$H_x^0 = -N_0 E_0^+ e^{-u_0 z} + N_0 E_0^- e^{u_0 z} \qquad \text{(A.2.23)}$$

$$H_x^0 = N_1 E_1^+ e^{-u_0 z} \qquad \text{(A.2.24)}$$

dimana:

$$N_0 = \frac{u_0}{i\omega\varepsilon_0} \quad \text{dan} \quad N_1 = \frac{u_2}{i\omega\mu_0}$$

Persamaan tangensial E dan H pada Z=0, didapatkan:

$$E_1^+ = E_0^+ + E_0^- \tag{A.2.25}$$

$$N_1 H_1^+ = N_0 H_0^+ - N_0 H_0^- \tag{A.2.26}$$

Dengan memecahkan dua persamaan diatas, maka kita dapatkan:

$$E_1^+ = \frac{2N_0}{N_0 + N_1} E_0^+ \quad \text{(gel. transmisi)} \tag{A.2.27}$$

$$E_0^+ = \frac{N_0 - N_1}{N_0 + N_1} E_0^+ \quad \text{(gel. refleksi)} \tag{A.2.28}$$

Untuk kasus TM, impedansi permukaan pada z=0 diberikan oleh:

$$Z = \left.\frac{E_x}{E_y}\right|_{z=0} = \frac{K_1 H_1^+}{H_1^+} = K_1$$

$$Z = \frac{u_1}{\sigma_1} = \frac{\left(\lambda^2 - k_1^2\right)^{1/2}}{\sigma_1} = \frac{\left(k_0^2 \sin^2\theta_0 - k_1^2\right)^{1/2}}{\sigma_1} \tag{A.2.29}$$

$$Z = \frac{ik_1}{\sigma_1}\left[1 - \frac{k_0^2}{k_1^2}\sin^2\theta_0\right]^{1/2}$$

karena $\left[\frac{k_0}{k_1}\right]^2 << 1$ dan $\sin\theta \leq 1$ maka :

$$Z = \frac{ik_1}{\sigma_1} = \frac{i\left(-\omega\mu_0\sigma_1\right)}{\sigma_1} = \left(\omega\mu_0\rho_1\right)^{1/2} e^{i\frac{\pi}{4}}$$

Dari persamaan diatas untuk TM gelombang bidang yang datang dengan sudut tertentu o, maka impedansi permukaan tidak tergantung pada sudut tersebut dan akan sama dengan impedansi untuk normal insiden (2.29).

Untuk kasus TE dari persamaan (A.2.21) dan (A.2.24), kita dapatkan:

$$Z = \frac{E_y}{H_x} = \frac{1}{N_1} \qquad \text{(A.2.30)}$$

$$Z = \frac{i\omega\mu_0}{u_1}$$

$$\text{atau } Z = \frac{i\omega\mu_0}{ik_1} = \frac{\varpi\mu_0}{\left(-i\omega\mu_0\sigma_1\right)^{1/2}} = \left(\omega\mu_0\rho_1\right)^{1/2} e^{i\frac{\pi}{4}}$$

Berdasarkan hasil yang didapatkan bahwa gelombang bidang akan menjalar vertikal kedalam bumi, berapapun sudut datangnya karena bumi berperilaku sebagai konduktor yang baik. Dalam kasus TE dan TM didapatkan bahwa impedansi permukaan keduanya adalah sama.

C. IMPEDANSI PADA KONDISI ISOLATOR DAN KONDUKTIF.

Untuk mendapatkan harga impedansi pada permukaan sebagai persamaan (2.36) maka untuk z=0, persamaan (2.34) dan (2.35) akan menjadi :

$$Z_0 = \eta_1 \frac{E_1^+ + E_1^-}{E_1^+ - E_1^-} = \frac{\omega\mu_0}{k_1}\left[\frac{1+\frac{E_1^-}{E_1^+}}{1-\frac{E_1^-}{E_1^+}}\right] \qquad \text{(A.3.1)}$$

Persamaan kontinuitas medan tangensial pada z=d adalah:

$$E_1^+ e^{-ik_1 d} + E_1^- e^{-ik_1 d} = E_2^+ e^{-ik_2 d} \qquad \text{(A.3.2)}$$

$$\frac{E_1^+}{\eta_1}e^{-ik_1d} - \frac{E_1^-}{\eta_1}e^{-ik_1d} = \frac{E_2^+}{\eta_2}e^{-ik_2d} \qquad \text{(A.3.3)}$$

Persamaan (A.3.2) dibagi dengan η_2 dan kurangkan pada persamaan (A.3.3), maka akan didapatkan:

$$\left[\frac{1}{\eta_2} - \frac{1}{\eta_1}\right]E_1^+e^{-ik_1d} + \left[\frac{1}{\eta_2} - \frac{1}{\eta_1}\right]E_1^-e^{-ik_1d} = 0$$

$$\frac{\eta_1+\eta_2}{\eta_1\eta_2}E_1^-e^{-ik_1d} = \frac{\eta_2+\eta_1}{\eta_{1\eta_2}}E_1^+e^{-ik_1d} \qquad \text{(A.3.4)}$$

substitusikan untuk η_1 dan η_2 maka akan didapatkan:

$$\frac{E_1^-}{E_1^+} = \frac{k_1-k_2}{k_1+k_2}e^{-i2k_1d} \qquad \text{(A.3.5)}$$

substitusikan persamaan (2.41) dan (A.3.1) maka:

$$\frac{E_1^-}{E_1^+} = \frac{\sigma_1^{1/2}-\sigma_2^{1/2}}{\sigma_1^{1/2}+\sigma_2^{1/2}}e^{-i2k_1d} = \frac{\rho_2^{1/2}-\rho_1^{1/2}}{\rho_1^{1/2}+\rho_2^{1/2}}e^{-i2k_1d} \qquad \text{(A.3.6)}$$

Akhirnya kita akan dapatkan impedansi dengan mensubstitusikan persamaan (A.3.6) ke dalam (A.3.5) :

$$Z = \left(\omega\mu_0\rho_1\right)^{1/2}e^{\frac{i\pi}{4}}\left[\frac{1+\dfrac{\rho_2^{1/2}-\rho_1^{1/2}}{\rho_2^{1/2}+\rho_1^{1/2}}e^{-izk_1d}}{1-\dfrac{\rho_2^{1/2}-\rho_1^{1/2}}{\rho_2^{1/2}+\rho_1^{1/2}}e^{-izk_1d}}\right] \qquad \text{(A.3.7)}$$

dengan resistivitas semu:

$$\rho a = \frac{1}{\omega\mu o}|zo|^2 \qquad \text{(A.3.8)}$$

Perhatikan bahwa untuk kasus frekwensi tinggi atau harga d yang sangat besar didapatkan:

$$e^{-ik2_1 d} = e^{-(2\omega\mu_0\sigma_1)^{1/2}d} e^{-i(2\omega\mu_0\sigma_1)^{1/2}} e^{-i(2\omega\mu_0\sigma_1)^{1/2}} = 0$$

sehingga :

$$\rho_a = \rho_1$$

Sedangkan untuk frekwensi rendah atau harga d yang kecil didapatkan :

$$e^{-i2k_1 d} \approx 1$$

sehingga :

$$\rho_a = \rho_2$$

Sekarang kita akan meninjau dua kasus yang berkaitan dengan keadaan basement.

a. Kondisi untuk basement merupakan isolator yang baik.

Untuk kondisi seperti ini, maka :

$$\rho_2 >> \rho_1$$

sehingga persamaan (A.3.7)akan menjadi:

$$Z_0 = \frac{\omega\mu_0}{k_1}\left[\frac{1+e^{-i2k_1 d}}{1-e^{-i2k_1 d}}\right] \qquad \text{(A.3.9)}$$

Pada keadaan frekwensi rendah, k,d <<1, sehingga kita dapat menbentuk persamaan eksponensial :

$$e^{-i2k_1 d} \approx 1 - i2k_1 d$$

atau

$$Z_0 \approx \frac{\omega\mu_0}{k_1}\left[\frac{2-e^{-i2k_1 d}}{2ik_1 d}\right] \approx \frac{\omega\mu_0}{k_1}\left[\frac{1}{ik_1 d}\right] = \frac{\omega\mu_0}{ik_1^2 d}$$

atau

$$Z_0 \approx \frac{\rho_1}{d}$$

$$\rho_a \approx \frac{\rho_1^2}{\omega\mu_1 d^2}, \qquad \rho_2 >> \rho_1 \tag{A.3.10}$$

b. Kondisi untuk basement yang konduktif.

Kondisi yang memenuhi adalah :

$$\rho_1 >> \rho_2$$

maka persamaan impedansi yang memenuhi kondisi diatas adalah:

$$Z_0 \approx \frac{\omega\mu_0}{k_1}\left[\frac{1-e^{i2k_1d}}{1+e^{i2k_1d}}\right]$$

$$Z_0 = \frac{\omega\mu_0}{k_1}\left[\frac{2ik_1d}{2-2ik_1d}\right] \approx \frac{\omega\mu_0}{k_1}(ik_1d) \tag{A.3.11}$$

$$Z_0 \approx i\omega\mu_0 d$$

$$\rho_a \approx \omega\mu_0 d^2$$

D. IMPEDANSI MEDIUM N-LAPIS.

Dari pembahasan untuk kasus model medium dua dan tiga lapis, kita dapat menuliskan persamaan medan untuk kedalaman z pada lapisan pertama adalah:

$$E_x^2 = E_1^+ e^{-ik_1z} + E_1^- e^{-ik_1z} \tag{A.4.1}$$

$$H_y^2 = \frac{E_1^+}{\eta_1} e^{-ik_1z} + \frac{E_1^-}{\eta_1} E_1^- e^{-ik_1z} \tag{A.4.2}$$

dengan:

$$\eta_1 = \frac{\omega\mu}{k_1}$$

dan impedansinya adalah:

$$Z(z) = \frac{\omega\mu E_1^+ e^{-ik_1 z} + E_1^- e^{ik_1 z}}{k_1 E_1^+ e^{-ik_1 z} - E_1^- e^{ik_1 z}} \qquad \text{(A.4.3)}$$

Dengan menggunakan identitas x/y = e $^{\ln x/y}$ pada persamaan (A.4.3),maka akan diperoleh

$$Z(z) = \frac{\omega\mu}{k_1}\left[\coth\left(ik_1 z - \tfrac{1}{2}\ln\left(\frac{E_1^-}{E_1^+}\right)\right)\right] \qquad \text{(A.4.4)}$$

Dari persamaan (A.4.4) diatas, kita dapat menuliskan kembali impedansi untuk 2 level kedalaman sebagai berikut:

$$Z(z_1) = \frac{\omega\mu}{k_1}\left[\coth\left(ik_1 z_1 - \tfrac{1}{2}\ln\left(\frac{E_1^-}{E_1^+}\right)\right)\right] \qquad \text{(A.4.5a)}$$

$$Z(z_2) = \frac{\omega\mu}{k_1}\left[\coth\left(ik_1 z_2 - \tfrac{1}{2}\ln\left(\frac{E_1^-}{E_1^+}\right)\right)\right] \qquad \text{(A.4.5b)}$$

Dengan mensubstitusikan persamaan (A.4.5a) kedalam (A.4.5b) diperoleh:

$$Z(z_2) = \frac{\omega\mu}{k_1}\left[\coth\left(ik_1(z_1 - z_2) + \coth^{-1}\left(\frac{k_1}{\omega\mu}(Z(z_2))\right)\right)\right]$$

Jika $z_1 = 0$ dan $z_2 = h_1$, maka didapat hubungan :

$$Z(0) = \frac{\omega\mu}{k_1}\left[\coth - ik_1 h_1 + \coth^{-1}\left(\frac{k_1}{\omega\mu}(Z(h_2))\right)\right] \qquad \text{(A.4.6)}$$

dengan $Z(h_1)$ adalah impedansi yang diukur pada kedalaman h_1 di lapisan 1. Untuk lapisan 2 didapatkan ::

$$Z(z_2) = \frac{\omega\mu}{k_1}\left[\coth ik_2 + \coth^{-1}\left(\frac{k_2}{\omega\mu}(Z(z_2))\right)\right]$$

dimana $h_1 < z < H_2 = h_1 + h_2$.

Jika $z = h_1$ dan $z_2 = h_1 + h_2$ maka akan diperoleh

$$Z(h) = \frac{\omega\mu}{k_2}\left[\coth ik_2h_2 + \coth^{-1}\left(\frac{k_2}{\omega\mu}(Z(H_2))\right)\right] \qquad \text{(A.4.7)}$$

Dengan mensubstitusikan persamaan (A.4.7) kedalam (A.4.6), maka akan diperoleh :

$$Z_n = \frac{\omega\mu}{k_2}\coth\left[-ik_1h_1 + \coth\frac{k_1}{k_2}\left(\coth(ik_2h_2)\coth^{-1}\frac{k^2}{\omega\mu}Z_{n-2}\right)\right]$$

atau

$$Z_n = \frac{\omega\mu}{k_1}\coth\left[-ik_1h_1 + \coth^{-1}\left(\frac{k_1}{\omega\mu}Z_{n-1}\right)\right] \qquad \text{(A.4.8)}$$

Dari kedua persamaan (A.4.8) kita akan memperoleh bentuk umum formula berulang untuk medium N-lapis, yaitu:

$$Z_n = \frac{\omega\mu}{k_1}\coth\left[-ik_1h_1 + \coth^{-1}\left(\frac{k_1}{\omega\mu}Z_{n-1}\right)\right]$$

$$Z_{n-1} = \frac{\omega\mu}{k_2}\coth\left[-ik_1h_1 + \coth^{-1}\left(\frac{k_1}{\omega\mu}Z_{n-2}\right)\right]$$

dst

$$Z_1 = \frac{\omega\mu}{k_n} \qquad \text{(A.4.9)}$$

dimana Zn adalah impedansi yang diukur di permukaan mediun n-lapis , Zn-1 adalah impedansi pada dasar lapisan1 dan seterusnya.

LAMPIRAN B

(HASIL PENGUKURAN TOPOGRAFI)

PROYEK:PANAS BUMI
LOKASI :G.WILIS
LINE : A

No	STN Lama	STN Baru	X	Y	Z
1	A0200	A0200	579103.761	9142055.709	1010.597
2	A0300	A0300	579188.722	9141991.752	1014.939
3	A0400	A0400	579253.737	9141939.496	1015.602
4	A0500	A0500	579354.443	9141868.343	1034.259
5	A0600	A0600	579420.419	9141799.386	1032.123
6	A0700	A0700	579492.094	9141747.059	1073.708
7	A0800	A0800	579585.130	9141690.310	1044.616
8	A0900	A0800	579668.671	9141629.333	1079.338
9	A0000	A1000	579739.850	9141568.326	1049.054
10	A0100	A1100	579820.012	9141507.076	1062.128
11	A0200	A1200	579901.358	9141446.642	1120.341
12	A0300	A1300	579975.671	9141390.894	1142.080
13	A0400	A1400	590052.972	9141327.314	1074.562

PROYEK:PANAS BUMI
LOKASI :G.WILIS
LINE : B

No	STN Lama	STN Baru	X	Y	Z
1	B0400	B0400	578945.375	9141528.066	1043.818
2	B0500	B0500	579021.842	9141456.800	1106.188
3	B0600	B0600	579096.457	9141383.303	1057.202
4	B0700	B0700	579177.555	9141340.692	1067.014
5	B0800	B0800	579252.833	9141259.173	1127.237
6	B0900	B0900	579327.206	9141205.330	1086.696
7	B0000	B1000	579401.606	9141142.973	1099.615
8	B0100	B1100	579493.678	9141091.800	1137.968
9	B0200	B1200	579563.655	9141029.558	1167.582
10	B0300	B1300	579636.153	9140965.183	1212.549
11	B0400	B1400	579717.790	9140904.719	1252.981
12	B0500	B1500	579797.121	9140843.688	1268.426
13	B0600	B1600	579870.346	9140786.010	1207.955
14	B0700	B1700	579963.631	9140717.554	1197.290
15	B0800	B1800	580045.988	9140662.433	1144.954
16	B0900	B1900	580136.119	9140618.617	1134.950
17	B1000	B2000	580198.171	9140593.024	1206.478
18	B1100	B2100	580259.082	9140507.045	1284.978
19	B1200	B2200	580332.587	9140432.107	1323.864
20	B1300	B2300	580406.874	9140364.536	1275.436
21	B1400	B2400	580484.475	9140296.574	127.623

PROYEK : PANAS BUMI
LOKASI :G.WILIS
LINE : C

No	STN	X	Y	Z
1	C0500	579051.312	9140771.620	1135.581
2	C0600	579131.637	9140729.510	1133.772
3	C0700	579221.845	9140666.300	1139.754
4	C0800	579293.732	9140599.110	1126.406
5	C0900	579379.969	9140542.190	1144.564
6	C1000	579455.606	9140476.069	1149.960
7	C1100	579534.381	9140220.414	1241.748
8	C1200	579614.344	9140352.225	1191.809
9	C1300	579693.038	9140291.868	1212.552
10	C1400	579777.245	9140232.876	1282.014
11	C1500	579856.057	9140160.157	1353.297
12	C1600	579935.776	9140110.114	1378.558
13	C1700	580015.159	9140050.029	1401.852
14	C1800	580094.675	9139989.413	1387.638
15	C1900	580172.571	9139925.345	1408.041
16	C2000	580252.094	9139865.028	1428.830
17	C2100	580332.717	9139806.216	1420.968
18	C2200	580410.600	9139743.320	1432.125
19	C2300	580489.453	9139682.222	1452.431
20	C2400	580568.992	9139621.372	1470.562
21	C2500	580649.879	9139561.086	1477.273
22	C2600	580727.796	9139499.436	1501.074
23	C2700	580807.080	9139439.615	1520.471
24	C2800	580886.114	9139378.691	1554.360
25	C2900	580966.428	9139318.396	1577.313
26	C3000	581054.784	9139257.107	1570.229
27	C3100	581124.045	9139193.487	1557.732
28	C3200	581203.432	9139134.206	1531.939
29	C3300	581284.411	9139074.875	1590.859
30	C3400	581361.514	9139013.885	1650.769
31	C3500	581440.064	9138952.372	1696.923
32	C3600	581518.436	9138890.971	1726.252
33	C3700	581598.959	9138832.233	1763.839
34	C3800	581678.546	9138771.172	1836.953
35	C3900	581757.748	9138708.413	1878.706
36	C4000	581836.286	9138648.574	1909.057
37	C4100	581915.909	9138587.372	1914.299
38	C4200	581995.072	9138526.420	1967.609
39	C4300	582075.318	9138465.466	200.678
40	C4400	582148.943	9138370.373	1939.899
41	C4500	582229.017	9138340.825	2004.075
42	C4600	582309.412	9138282.421	2086.251
43	C4700	582392.387	9138223.052	2135.091

PROYEK:PANAS BUMI
LOKASI :G.WILIS
LINE : D

No	STN	X	Y	Z
1	D0000	579671.706	9139678.679	1208.455
2	D0100	579582.208	9139746.383	1201.326
3	D0200	579513.557	9139797.793	1215.812
4	D0300	579434.495	9139863.067	1198.024
5	D0400	579359.651	9139923.747	1218.184
6	D0500	579275.981	9139994.383	1244.228
7	D0600	579194.696	9140043.655	1257.038
8	D0700	579153.576	9140075.704	1271.520
9	D0800	579234.811	9140014.801	1295.266
10	D0900	579321.390	9139953.386	1263.840
11	D1000	579394.401	9139894.788	1248.327
12	D1100	579470.895	9139828.370	1240.538
13	D1200	579548.975	9139766.772	1239.386
14	D1300	579630.182	9139704.431	1261.102
15	D1400	579708.880	9139645.408	1280.384
16	D1500	579793.997	9139580.395	1292.282
17	D1600	579870.217	9139525.289	1310.989
18	D1700	579949.416	9139465.508	1325.849
19	D1800	580030.686	9139406.088	1344.725
20	D1900	580107.916	9139341.596	1359.778
21	D2000	580185.560	9139280.364	1375.759
22	D2100	580265.825	9139217.685	1380.111
23	D2200	580346.788	9139158.689	1386.760
24	D2300	580422.826	9139099.152	1417.309
25	D2400	580496.411	9139034.233	1412.846
26	D2500	580574.892	9138968.764	1397.289
27	D2600	580658.885	9138910.373	1414.134
28	D2700	580741.762	9138847.575	1419.491
29	D2800	580826.026	9138781.922	1471.862
30	D2900	580895.812	9138718.978	1457.504
31	D3000	580977.352	9138870.794	1450.651
32	D3100	581069.120	9138807.176	1457.511
33	D3200	581141.279	9138545.819	1507.204
34	D3300	581216.221	9138487.425	1556.358
35	D3400	581305.401	9138421.367	1553.263
36	D3500	581385.629	9138355.947	1534.630
37	D3600	581466.919	9138291.648	1527.156
38	D3700	581539.318	9138232.145	1553.601
39	D3800	581619.884	9138173.582	1586.366
40	D3900	581728.149	9138079.064	1640.802
41	D4000	581767.377	9138048.360	1668.151
42	D4100	581855.086	9137982.255	1745.456
43	D4200	581923.611	9137915.683	1798.406
44	D4300	582006.949	9137859.584	1857.370
45	D4400	582104.139	9137806.293	1945.478
46	D4500	582198.083	9137771.762	2005.582
47	D4600	582293.777	9137742.227	2066.362
48	D4700	582383.766	9137697.889	2089.338

PROYEK:PANAS BUMI
LOKASI :G.WILIS
LINE : E

No	STN	X	Y	Z
1	E0000	577818.456	9140467.508	1088.193
2	E0100	577900.913	9140408.908	1098.232
3	E0200	577976.292	9140349.635	1113.273
4	E0300	578062.030	9140287.725	1102.119
5	E0400	578135.819	9140221.301	1095.191
6	E0500	578212.507	9140158.661	1089.557
7	E0600	578297.410	9140101.695	1106.293
8	E0700	578376.001	9140043.110	1118.162
9	E0800	578460.684	9139981.245	1147.827
10	E0900	578536.649	9139918.455	1181.530
11	E1000	578618.095	9139856.994	1187.564
12	E1100	578701.609	9139794.951	1194.166
13	E1200	578782.578	9139737.003	1215.583
14	E1300	578861.010	9139676.922	1212.147
15	E1400	578884.018	9139643.110	1203.003
16	E1500	579008.999	9139558.156	1172.470
17	E1600	579092.370	9139491.971	1188.062
18	E1700	579182.454	9139428.886	1274.564
19	E1800	59253.960	9139368.902	1282.527
20	E1900	579337.107	9139308.605	1299.399
21	E2000	579409.595	9139254.315	1343.894
22	E2100	579487.906	9139190.932	1348.810
23	E2200	579569.323	9139120.154	1361.069
24	E2300	579645.437	9139066.911	1368.910
25	E2400	579740.225	9139009.936	1425.721
26	E2500	579812.718	9138942.540	1463.539
27	E2600	579882.182	9138890.603	1468.261
28	E2700	579961.043	9138814.618	1479.647
29	E2800	580041.294	9138768.477	1461.055
30	E2900	580118.892	9138707.240	1482.294
31	E3000	580214.818	9138648.117	1587.562
32	E3100	580284.813	9138588.420	1650.987
33	E3200	580367.726	9138525.801	1682.233
34	E3300	580438.788	9138457.587	1747.550
35	E3400	580517.274	9138398.719	1730.451
36	E3500	580594.023	9138330.290	1772.470
37	E3600	580671.787	9138258.510	1749.788

PROYEK:PANAS BUMI
LOKASI :G.WILIS
LINE : F

No	STN Lama	STN Baru	X	Y	Z
4	F0300	F0300	576758.783	9140650.672	971.913
5	F0400	F0400	576757.072	9140648.300	971.913
6	F0500	F0500	576823.622	9140522.779	1005.824
7	F0600	F0600	577006.813	9140466.572	972.654
8	F0700	F0700	577079.882	9140410.662	978.090
9	F0800	F0800	577160.291	9140345.912	1011.352
10	F0900	F0900	577244.453	9140281.184	1048.032
11	F0000	F1000	577323.080	9140221.857	1075.978
12	F0100	F1100	577410.068	9140171.157	1089.972
13	F0200	F1200	577496.708	9140108.848	1092.553
14	F0300	F1300	577567.488	9140053.007	1097.946
15	F0400	F1400	577651.620	9139998.898	1107.856
16	F0500	F1500	577720.587	9139915.068	1112.640
17	F0600	F1600	577790.576	9139864.177	1057.760
18	F0700	F1700	577881.038	9139793.745	1058.508
19	F0800	F1800	577963.749	9139725.711	1076.262
20	F0900	F1900	578030.648	9139673.034	1108.994
21	F1000	F2000	578114.592	9139612.240	1131.684
22	F1100	F2100	578192.823	9139551.576	1143.323
23	F1200	F2200	578272.253	9139488.996	1158.958
24	F1300	F2300	578352.509	9139427.773	1157.959
25	F1400	F2400	578432.083	9139367.282	1164.898
26	F1500	F2500	578510.903	9139306.682	1179.560
27	F1600	F2600	578593.034	9139248.625	1164.052
28	F1700	F2700	578669.392	9139173.470	1170.157
29	F1800	F2800	578747.825	9139133.470	1220.099
30	F1900	F2900	578830.004	9139064.093	1258.256
31	F2000	F3000	578910.732	9139005.375	1270.784
32	F2100	F3100	579080.546	9138937.951	1268.317
33	F2200	F3200	579052.857	9138877.965	1312.604
34	F2300	F3300	579145.769	9138815.440	1336.267
35	F2400	F3400	579226.320	9138756.722	1358.764
36	F2500	F3500	579297.698	9138693.207	1381.097
37	F2600	F3600	579387.567	9138643.310	1422.172
38	F2700	F3700	579463.213	9138570.319	1474.744
39	F2800	F3800	579539.331	9138510.688	1531.644
40	F2900	F3900	57612.672	9138449.945	1565.335
41	F3000	F4000	579700.410	9138395.222	1606.639
42	F3100	F4100	579793.887	9138338.378	1603.237
43	F3200	F4200	579864.323	9138288.456	1582.850
44	F3300	F4300	579938.305	9138220.226	1579.195
45	F3400	F4400	580009.221	9138150.110	1655.122
46	F3500	F4500	580103.093	9138101.827	1730.331

PROYEK:PANAS BUMI
LOKASI :G.WILIS
LINE : G

No	STN Lama	STN Baru	X	Y	Z
1	G0200	G0200	576552.311	9140183.109	1106.219
2	G0300	G0300	576630.050	9140125.068	1096.538
3	G0400	G0400	576711.509	9140062.277	1116.535
4	G0500	G0500	576789.812	9139999.758	1069.543
5	G0600	G0600	576871.750	9139941.304	1076.678
6	G0700	G0700	576949.881	9139884.917	1036.077
7	G0800	G0800	577028.597	9139825.048	1096.600
8	G0900	G0800	577104.697	9139761.319	1025.405
9	G0000	G1000	577187.347	9139698.952	1005.891
10	G0100	G1100	577268.981	9139640.775	1007.466
11	G0200	G1200	577345.443	9139579.129	1014.021
12	G0300	G1300	577426.108	9139516.542	1030.782
13	G0400	G1400	577503.487	9139456.679	1060.701
14	G0500	G1500	577578.939	9139396.176	1051.671
15	G0600	G1600	577657.118	9139338.478	1069.342
16	G0700	G1700	577732.942	9139279.927	1117.108
17	G0800	G1800	577814.155	9139218.013	1123.712
18	G0900	G1900	577894.318	9139157.065	1122.649
19	G1000	G2000	577971.181	9139099.090	1135.545
20	G1100	G2100	578054.126	9139036.632	1170.783
21	G1200	G2200	578127.788	9138982.912	1209.461
22	G1300	G2300	578205.522	9138925.007	1224.924
23	G1400	G2400	578290.468	9138858.911	1241.761
24	G1500	G2500	578374.111	9138794.925	1278.307
25	G1600	G2600	578455.467	9138738.601	1299.586
26	G1700	G2700	578535.771	9138671.887	1293.892
27	G1800	G2800	578616.636	9138607.537	1284.751
28	G1900	G2900	578697.961	9138546.938	1304.105
29	G2000	G3000	578781.523	9138479.804	1340.619
30	G2100	G3100	578865.784	9138419.462	1386.264
31	G2200	G3200	578947.553	9138357.286	1422.786
32	G2300	G3300	579020.355	9138298.795	1448.852
33	G2400	G3400	579100.748	9138238.383	1443.736
34	G2500	G3500	579178.758	9138176.784	1435.799
35	G2600	G3600	579251.212	9138121.500	1441.326
36	G2700	G3700	579343.429	9138040.913	1453.156
37	G2800	G3800	579416.291	9137986.648	1462.567
38	G2900	G3900	579495.622	9137938. 196	1505.108
39	G3000	G4000	579568.366	9137880. 948	1596.736
40	G3100	G4100	579645.599	9137821.835	1624.487
41	G3200	G4200	579729.191	9137758. 192	1649.525
42	G3300	G4300	579802.560	9137702.097	1718.610
43	G3400	G4400	579880.666	9137638. 193	1718.682
44	G3500	G4500	579967.973	9137575.026	1764.202
45	G3600	G4600	580042.865	9137521. 186	1753.983
46	G3700	G4700	580129.518	9137461.025	1696.158
47	G3800	G4800	580201.586	9137386.924	1679.802
48	G3900	G4900	580288.842	9137319.309	1774.585
49	G4000	G5000	580364.656	9137245.731	1725.944

PROYEK :PANAS BUMI
LOKASI :G.WILIS
LINE :I

No	STN Lama	STN Baru	X	Y	Z
1		I0400	576074.782	9139412.551	1361.870
2		I0500	576157.507	9139346.074	1312.453
3		I0600	576239.761	9139286.549	1235.755
4		I0700	576321.374	9139226.583	1221.369
5		I0800	576394.763	9139167.105	1289.393
6		I0900	576479.297	9139103.957	1262.926
7		I1000	576546.567	9139050.069	1218.521
8		I1100	576626.748	9138989.177	1158.233
9		I1200	576717.652	9138924.315	1186.094
10		I1300	576794.946	9138872.712	1145.852
11		I1400	576873.733	9138811.457	1178.523
12		I1500	576955.737	9138752.601	1199.737
13		I1600	577037.192	9138690.584	1184.392
14		I1700	577117.858	9138637.113	1145.214
15		I1800	577195.465	9138575.047	1121.871
16		I1900	577271.541	9138516.728	1160.773
17	I0000	I2000	577294.945	9138371.564	1219.207
18	I0100	I2100	577374.475	9138311.939	1244.444
19	I0200	I2200	577455.074	9138256.066	1247.479
20	I0300	I2300	577527.646	9138196.336	1227.418
21	I0400	I2400	577614.812	9138128.490	1208.164
22	I0500	I2500	577693.957	9138068.670	1196.364
23	I0600	I2600	577775.463	9138009.273	1231.004
24	I0700	I2700	577852.297	9137948.052	1262.930
25	I0800	I2800	577932.945	9137886.308	1242.512
26	I0900	I2900	578011.813	9137825.483	1261.796
27	I1000	I3000	578090.950	9137764.193	1289.105
28	I1100	I3100	578169.048	9137701.298	1314.251
29	I1200	I3200	578249.065	9137640.869	1270.063
30	I1300	I3300	578326.181	9137578.480	1245.681
31	I1400	I3400	578406.282	9137519.127	1256.468
32	I1500	I3500	578486.348	9137457.779	1279.209
33	I1600	I3600	578565.374	9137396.861	1284.220
34	I1700	I3700	578644.254	9137335.365	1322.348
35	I1800	I3800	578723.561	9137275.285	1331.724
36	I1900	I3900	578803.509	9137214.633	1317.011
37	I2000	I4000	578803.509	9137214.633	1317.011
38	I2100	I4100	578962.080	9137092.260	1368.495
39	I2200	I4200	579040.837	9137031.277	1385.033
40	I2300	I4300	579120.204	9136970.631	1395.300
41	I2400	I4400	579200.579	9136911.559	1430.198
42	I2500	I4500	579281.983	9136851.325	1505.456
43	I2600	I4600	579361.301	9136789.917	1551.806
44	I2700	I4700	579439.386	9136728.500	1591.273
45	I2800	I4800	579519.049	9136668.332	1662.705
46	I2900	I4900	579597.940	9136606.869	1752.186
47	I3000	I5000	579676.394	9136546.125	1811.526
48	I3100	I5100	579756.493	9136485.164	1805.838
49	I3200	I5200	579835.372	9136423.370	1758.465

PROYEK :PANAS BUMI
LOKASI :G.WILIS
LINE : J

No	STN Lama	STN Baru	X	Y	Z
1		J0100	576935.883	9138112.958	1336.716
2		J0200	576668.532	9138082.075	1288.077
3		J0300	576743.580	9137987.690	1285.720
4		J0400	576826.387	9137907.230	1297.651
5		J0500	576908.523	9137844.790	1332.246
6		J0600	576982.060	9137791.457	1441.277
7		J0700	577064.801	9137731.136	1412.210
8		J0800	577146.110	9137672.320	1407.264
9		J0900	577226.604	9137612.672	1382.025
10	J0000	J1000	577298.910	9137554.500	1341.141
11	J0100	J1100	577219.169	9137606.829	1376.011
12	J0200	J1200	577295.406	9137545.798	1330.202
13	J0300	J1300	577377.966	9137486.019	1317.807
14	J0400	J1400	577456.518	9137428.406	1352.209
15	J0500	J1500	577540.317	9137368.964	1309.168
16	J0600	J1600	577621.201	9137311.327	1367.350
17	J0700	J1700	577700.973	9137249.087	1425.095
18	J0800	J1800	577781.112	9137189.749	1452.882
19	J0900	J1900	577861.753	9137130.761	1475.762
20	J1000	J2000	577941.306	9137068.585	1500.509
21	J1100	J2100	578021.075	9137008.141	1511.138
22	J1200	J2200	578100.540	9136947.082	1517.187
23	J1300	J2300	578178.028	9136888.153	1542.036
24	J1400	J2400	578257.018	9136825.920	1554.271
25	J1500	J2500	578337.107	9136764.009	1567.249
26	J1600	J2600	578418.700	9136705.623	1577.315
27	J1700	J2700	578496.400	9136642.875	1536.025
28	J1800	J2800	578580.635	9136585.202	1597.800
29	J1900	J2900	578654.122	9136521.257	1607.501
30	J2000	J3000	578737.743	9136455.977	1637.817
31	J2100	J3100	578821.149	9136405.684	1653.670
32	J2200	J3200	578899.842	9136352.772	1682.951
33	J2300	J3300	578977.080	9136289.006	1720.397
34	J2400	J3400	579055.112	9136230.500	1746.781
35	J2500	J3500	579137.056	9136161.582	1785.268
36	J2600	J3600	579219.675	9136101.643	1822.017
37	J2700	J3700	579304.452	9136049.301	1881.483
38	J2800	J3800	579377.359	9135979.594	1916.704
39	J2900	J3900	579453.824	9135917.049	1914.996
40	J3000	J4000	579533.694	9135855.181	1878.541
41	J3100	J4100	579610.403	9135792.145	1845.068
42	J3200	J4200	579693.812	9135733.283	1782.016
43	J3300	J4300	579769.858	9135671.485	1730.462
44	J3400	J4400	579844.609	9135604.205	1762.644
45	J3500	J4500	579927.994	9135547.530	1903.189
46	J3600	J4600	580010.023	135490.933	1782.020
47	J3700	J4700	580087.179	9135429.294	1732.182
48	J3800	J4800	580164.412	9135364.391	1750.499
49	J3900	J4900	580245.982	9135306.831	1795.655

PROYEK :PANAS BUMI
LOKASI :G.WILIS
LINE :K

No	STN Lama	STN Baru	X	Y	Z
1		K0500	576126.691	9137904.890	1465.408
2		K0600	576203.926	9137794.172	1436.279
3		K0700	576277.276	9137684.084	1422.491
4		K0800	576347.993	9137575.680	1457.084
5		K0900	576425.527	9137459.459	1530.083
6		K1000	576508.853	9137464.607	1566.232
7		K1100	576590.729	9137440.186	1594.062
8		K1200	576670.239	9137381.780	1542.932
9		K1300	576756.101	9137323.658	1513.076
10		K1400	576840.299	9137276.371	1499.117
11		K1500	576916.256	9137212.800	1485.917
12		K1600	576995.755	9137155.840	1452.568
13		K1700	577064.927	9137106.296	1434.248
14		K1800	577157.251	9137031.753	1485.729
15		K1900	577240.710	9136974.915	1475.717
16	K0000	K2000	577320.296	9136913.441	1484.135
17	K0100	K2100	577397.391	9136848.025	1469.375
18	K0200	K2200	577477.953	9136788.285	1474.390
19	K0300	K2300	577560.824	9136732.092	1468.177
20	K0400	K2400	577640.042	9136672.712	1462.957
21	K0500	K2500	577719.850	9136615.234	1456.456
22	K0600	K2600	577799.519	9136555.776	1455.151
23	K0700	K2700	577875.744	9136495.031	1479.351
24	K0800	K2800	577957.733	9136430.927	1498.220
25	K0900	K2900	578041.723	9136368.167	1527.647
26	K1000	K3000	578123.735	9136311.400	1495.447
27	K1100	K3100	578197.382	9136238.817	1454.925
28	K1200	K3200	578271.725	9136172.736	1500.688
29	K1300	K3300	578354.052	9136122.719	1551.549
30	K1400	K3400	578438.975	9136061.791	1524.758
31	K1500	K3500	578521.667	9135995.329	1513.126
32	K1600	K3600	578601.121	9135934.301	1493.449
33	K1700	K3700	578671.098	9135872.882	1573.222
34	K1800	K3800	578745.711	9135813.608	1649.124
35	K1900	K3900	578831.242	9135750.636	1679.183
36	K2000	K4000	578919.083	9135691.823	1644.630
37	K2100	K4100	579002.606	9135636.091	1659.768
38	K2200	K4200	579076.879	9135567.248	1671.846
39	K2300	K4300	579154.881	9135503.902	1666.343
40	K2400	K4400	579233.267	9135444.210	1601.090
41	K2500	K4500	579307.847	9135384.515	1581.261
42	K2600	K4600	579385.047	9135321.401	1618.342
43	K2700	K4700	579467.134	9135261.020	1678.926
44	K2800	K4800	579550.808	9135207.117	1687.522
45	K2900	K4900	579629.846	9135144.551	1721.901
46	K3000	K5000	579705.595	9135083.034	1755.814
47	K3100	K5100	579787.255	9135019.356	1804.610
48	K3200	K5200	579865.531	9134953.081	1882.131
49	K3300	K5300	579949.389	9134910.680	1851.955

PROYEK :PANAS BUMI
LOKASI :G.WILIS
LINE : L

No	STN Lama	STN Baru	X	Y	Z
1		L0000	576842.828	9137421.327	1393.088
2		L0100	576914.386	9137350.777	1386.872
3		L0200	576907.823	9137295.848	1373.687
4		L0300	576974.368	9137235.297	1420.866
5		L0400	576158.845	9137171.752	1481.195
6		L0500	576239.351	9137111.959	1524.066
7		L0600	576311.838	9137057.998	1577.253
8		L0700	576381.088	9137005.788	1617.063
9		L1000	576463.193	9136942.005	1566.226
10		L1100	576543.759	9136880.836	1530.558
11		L1200	576622.061	9136818.892	1513.678
12		L1300	576699.748	9136752.445	1492.884
13		L1400	576778.011	9136693.822	1536.590
14		L1500	576852.474	9136636.437	1500.299
15		L1600	576933.493	9136684.795	1490.528
16		L1700	577018.178	9136510.887	1483.560
17		L1800	577094.188	9136452.441	1403.334
18		L1900	577173.402	9136390.024	1382.181
19	L0000	L2000	577253.200	9136327.606	1359.445
20	L0100	L2100	577329.902	9136268.311	1392.615
21	L0200	L2200	577407.251	9136570.681	1427.518
22	L0300	L2300	577489.259	9136148.388	1386.014
23	L0400	L2400	577566.528	9136086.377	1435.752
24	L0500	L2500	577653.294	9136023.147	1432.877
25	L0600	L2600	577732.278	9135963.316	1441.497
26	L0700	L2700	577812.292	9135901.491	1447.921
27	L0800	L2800	577890.819	9135841.525	1376.375
28	L0900	L2900	577965.027	9135781.256	1387.384
29	L1000	L3000	578039.256	9135723.453	1449.660
30	L1100	L3100	578121.268	9135660.718	1493.687
31	L1200	L3200	578201.815	9135599.975	1528.426
32	L1300	L3300	578282.346	9135539.547	1525.966
33	L1400	L3400	578359.642	9135478.342	1481.482
34	L1500	L3500	578439.007	9135418.050	1480.905
35	L1600	L3600	578520.347	9135358.184	1517.696
36	L1700	L3700	578596.259	9135298.582	1517.527
37	L1800	L3800	578673.444	9135238.777	1463.981
38	L1900	L3900	578756.295	9135176.883	1430.895
39	L2000	L4000	578834.609	9135114.994	1408.462
40	L2100	L4100	578917.539	9135054.257	1473.662
41	L2200	L4200	578995.826	9134991.646	1478.479
42	L2300	L4300	579074.492	9134932.327	1564.245
43	L2400	L4400	579157.104	9134870.935	1625.352
44	L2500	L4500	579238.358	9134809.917	1680.112
45	L2600	L4600	579321.063	9134745.782	1754.299
46	L2700	L4700	579396.323	9134687.249	1810.603
47	L2800	L4800	579440.393	9134653.061	1793.129
48	L2900	L4900	579558.903	9134581.189	1756.370
49	L3000	L5000	579637.056	9134501.500	1769.018

PROYEK :PANAS BUMI
LOKASI :G.WILIS
LINE : M

No	STN Lama	STN Baru	X	Y	Z
1		M0000	576011.548	9136611.170	1597.489
2		M0100	576020.078	9136599.400	1598.688
3		M1000	576178.760	9136499.900	1505.495
4		M1100	576255.910	9136439.303	1473.334
5		M1200	576333.680	9136378.332	1426.656
6		M1300	576420.295	9136338.342	1407.035
7		M1400	576493.638	9136287.613	1372.080
8		M1500	576571.044	9136211.700	1372.430
9		M1600	576646.068	9136145.237	1343.765
10		M1700	576723.765	9136081.997	1326.342
11		M1800	576800.361	9136016.522	1349.623
12		M1900	576882.883	9135947.497	1348.649
13	M0000	M2000	576934.468	9135900.388	1291.165
14	M0100	M2100	577016.818	9135844.817	1308.885
15	M0200	M2200	577104.163	9135784.333	1284.235
16	M0300	M2300	577187.019	9135716.919	1334.477
17	M0400	M2400	577274.104	9135663.056	1360.769
18	M0500	M2500	577353.371	9135608.007	1312.829
19	M0600	M2600	577442.513	9135519.755	1305.663
20	M0700	M2700	577517.561	9135460.532	1283.979
21	M0800	M2800	577593.865	9135392.004	1411.676
22	M0900	M2900	577675.468	9135341.523	1412.206
23	M1000	M3000	577770.442	9135289.441	1336.565
24	M1100	M3100	577848.718	9135221.325	1354.624
25	M1200	M3200	577917.855	9135152.378	1379.238
26	M1300	M3300	578007.116	9135088.446	1436.397
27	M1400	M3400	578088.186	9135027.891	1417.684
28	M1500	M3500	578165.811	9134964.337	1359.916
29	M1600	M3600	578249.557	9134901.879	1351.363
30	M1700	M3700	578326.016	9134837.709	1396.765
31	M1800	M3800	578405.759	9134780.280	1465.859
32	M1900	M3900	578488.041	9134717.311	1512.167
33	M2000	M4000	578574.940	9134650.937	1479.827
34	M2100	M4100	578646.847	9134588.704	1518.447
35	M2200	M4200	578736.722	9134542.028	1574.041
36	M2300	M4300	578823.993	9134480.152	1616.368
37	M2400	M4400	578891.832	9134406.734	1595.671
38	M2500	M4500	578963.255	9134345.585	1598.329
39	M2600	M4600	579050.894	9134285.768	1600.763
40	M2700	M4700	579139.585	9134220.637	1572.233
41	M2800	M4800	579221.854	9134166.597	1536.963
42	M2900	M4900	579295.317	9134088.791	1550.353
43	M3000	M5000	579376.778	9134048.908	1604.878

PROYEK : PANAS BUMI
LOKASI : G.WILIS
LINE : N

No	STN Lama	STN Baru	X	Y	Z
1		N0900	575687.367	9136722.492	1548.369
2		N0900	575767.369	9136760.990	1481.459
3		N1000	575841.579	9136106.679	1450.213
4		N1100	575915.961	9136053.368	1478.779
5		N1200	576009.368	9135977.884	1529.101
6		N1300	576087.572	9135917.182	1568.004
7		N1400	576159.325	9135861.899	1519.487
8		N1500	576246.700	9135794.724	1497.314
9		N1600	576324.050	9135733.631	1530.363
10		N1700	576402.868	9135672.945	1486.168
11		N1800	576472.182	9135620.593	1415.754
12		N1900	576551.750	9135560.571	1360.552
13	N0000	N2000	576633.171	9135499.287	1354.799
14	N0100	N2100	576715.658	9135436.878	1325.999
15	N0200	N2200	576795.985	9135375.643	1279.801
16	N0300	N2300	576878.491	9135314.754	1255.225
17	N0400	N2400	576956.349	9135256.811	1208.790
18	N0500	N2500	577034.506	9135196.957	1241.411
19	N0600	N2600	577115.671	9135136.295	1300.480
20	N0700	N2700	577199.725	9135072.106	1320.388
21	N0800	N2800	577288.576	9135010.523	1352.349
22	N0900	N2900	577358.649	9134953.612	1371.986
23	N1000	N3000	577438.794	9134892.063	1381.437
24	N1100	N3100	577518.208	9134829.882	1314.421
25	N1200	N3200	577601.063	9134766.839	1260.443
26	N1300	N3300	577679.661	9134707.760	1312.595
27	N1400	N3400	577760.918	9134648.522	1334.497
28	N1500	N3500	577840.931	9134585.627	1373.491
29	N1600	N3600	577919.177	9134525.172	1410.579
30	N1700	N3700	578005.877	9134459.463	1408.751
31	N1800	N3800	578075.574	9134408.093	1429.137
32	N1900	N3900	578161.559	9134341.902	1360.557
33	N2000	N4000	578242.022	9134280.854	1423.188
34	N2100	N4100	578325.957	9134217.455	1454.953
35	N2200	N4200	578413.440	9134151.103	1507.507
36	N2300	N4300	578485.015	9134095.729	1511.075
37	N2400	N4400	578565.186	9134035.030	1482.072
38	N2500	N4500	578648.026	9133972.188	1400.573
39	N2600	N4600	578716.481	9133918.466	1354.735
40	N2700	N4700	578794.651	9133857.831	1407.269
41	N2800	N4800	578868.012	9133804.830	1493.774
42	N2900	N4900	578955.363	9133738.027	1482.897
43	N3000	N5000	579027.348	9133685.393	1476.173

PROYEK :PANAS BUMI
LOKASI :G.MILIS
LINE : O

No	STN Lama	STN Baru	X	Y	Z
1	O0000	O0000	576329.922	9135069.048	1452.177
2	O0100	O0100	576408.900	9135038.612	1375.143
3	O0200	O0200	576491.310	9134975.603	1295.482
4	O0300	O0300	576569.576	9134956.751	1307.751
5	O0400	O0400	576648.461	9134954.824	1165.279
6	O0500	O0500	576728.766	9134794.911	1154.724
7	O0600	O0600	576812.163	9134731.697	1224.699
8	O0700	O0700	576889.707	9134675.442	1282.831
9	O0800	O0800	576968.262	9134618.791	1245.288
10	O0900	O0900	577046.722	9134555.069	1221.910
11	O1000	O1000	577118.695	9134491.950	1192.727
12	O1100	O1100	577206.345	9134432.275	1259.726
13	O1200	O1200	577288.953	9134368.911	1278.579
14	O1300	O1300	577359.785	9134312.821	1284.623
15	O1400	O1400	577441.864	9134249.653	1340.824
16	O1500	O1500	577518.042	9134190.973	1315.005
17	O1600	O1600	577600.158	9134125.544	1282.354
18	O1700	O1700	577687.799	9134065.066	1228.758
19	O1800	O1800	577760.990	9134002.810	1286.526
20	O1900	O1900	577845.753	9133939.390	1355.219
21	O2000	O2000	577929.004	9133874.712	1342.322
22	O2100	O2100	578000.237	9133823.348	1389.089
23	O2200	O2200	578081.081	9133761.650	1385.659
24	O2300	O2300	578162.129	9133701.965	1376.209
25	O2400	O2400	578237.660	9133643.066	1416.659
26	O2500	O2500	578320.627	9133579.771	1390.726
27	O2600	O2600	578395.974	9133520.915	1346.532
28	O2700	O2700	578475.964	9133458.157	1299.877
29	O2800	O2800	578556.759	9133394.637	1251.445
30	O2900	O2900	578644.380	9133335.120	1342.259
31	O3000	O3000	578725.083	9133275.028	1391.229

LAMPIRAN C

(HASIL PENGUKURAN CSAMT)

Line A
CSAMT ZONGE
for
PERTAMINA UEP III

Field Job 002
ZONGE ZPLOT 7.0E
Plotted 08 Nov 94

CSAMT SURVEY DATA
CAGNIARD RESISTIVITY

values in ohm-meters

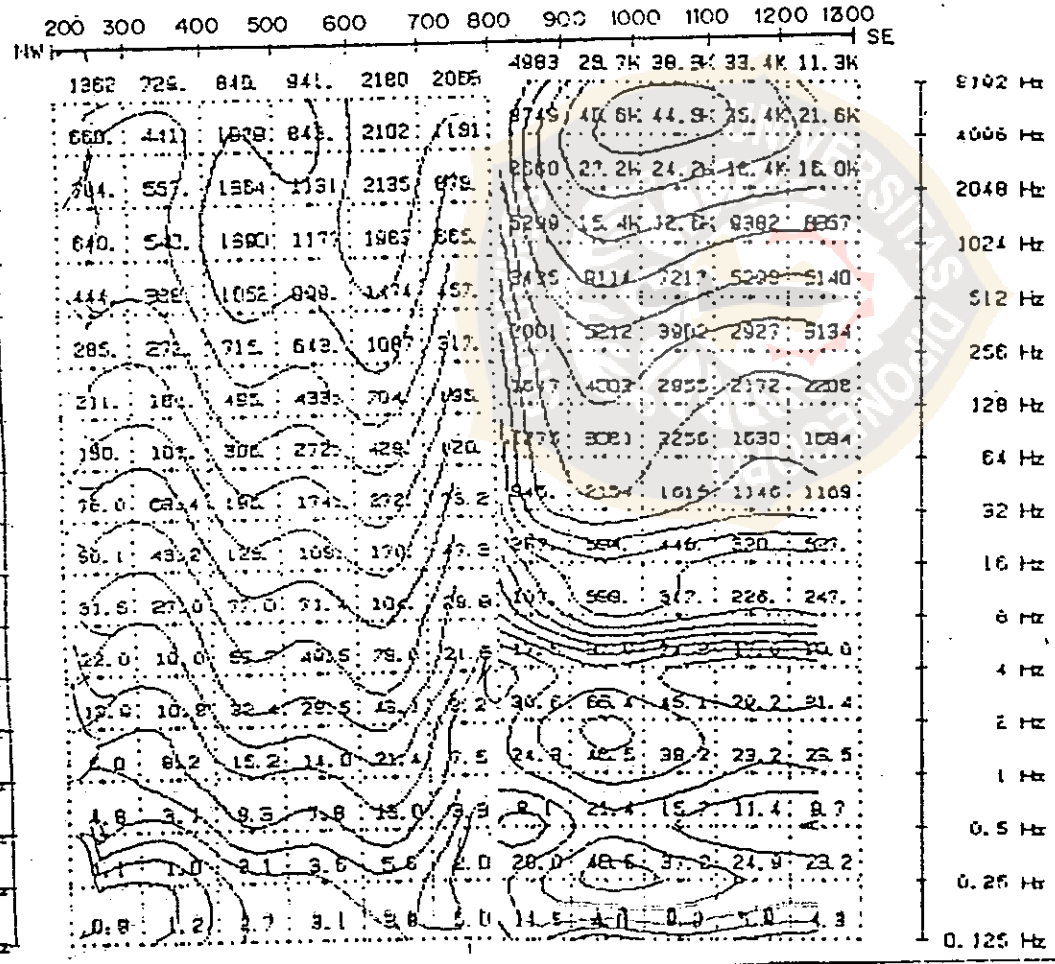
RECEIVER DATA
Length = 100.0 Dipole = NW
Spacing= 100.0 Dipole= SE

Surveyed= 29 Oct 94

TRANSMITTER DATA
Length = 4000 m
Orient. = SE
Distance= 7000 m
Rx to Tx= NE

Plot limited and LOGARITHMIC CONTOURS
(Interval: 0.20)

[773]	63.1
1.00	100.
1.58	158.
2.51	251.
3.98	398.
6.31	631.
10.0	1000
15.8	1585
25.1	[2377]
39.8	



Lampiran C-1

Line 3

CSAMT ZONGE
for
PERTAMINA UEP III

Field Iso 002
ZONGE PLOT 7.05
Plotted 01 Nov 94

CAGNIARD RESISTIVITY

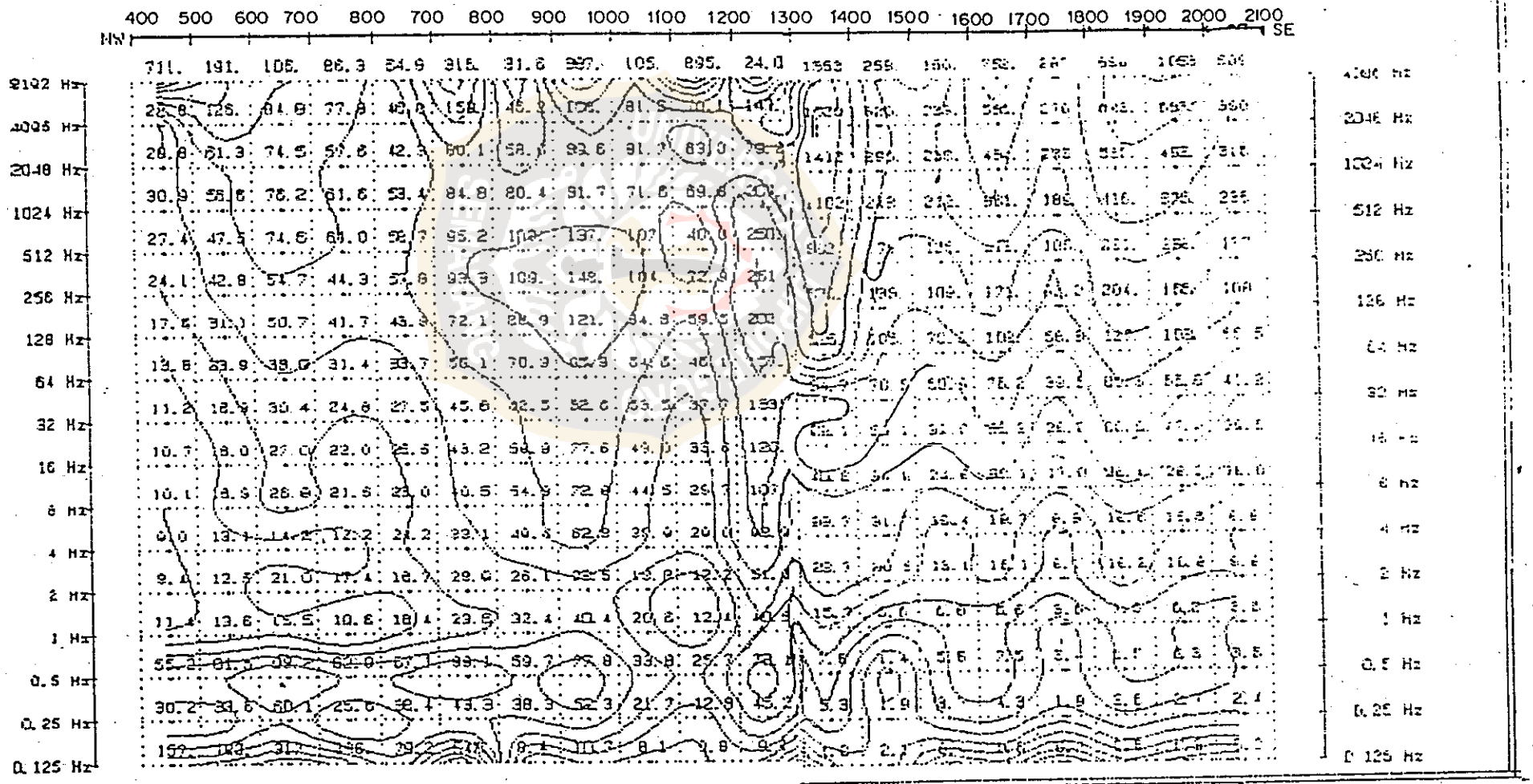
values in ohm-meters

RECEIVER DATA
Length = 100. Ohms = NV
Spacing= 100. Dipole= SE
Surveyed= 22-24 Oct

TRANSMITTER DATA
Length = 4000 m
Orient. = SE
Distance= 7000 m
Rx to Tx= NE

(Increment: 0.20)

[1.68]	158.
2.51	251.
3.98	398.
5.31	531.
10.0	1000
15.8	1585
25.1	2512
39.8	3981
63.1	[4406]
100.	



Lampiran C-2

OSANT ZONGE

for

PERTAMINA UEP III

Field Job 002
ZONGE TECH 7.0E
Plotted 30 Oct 94

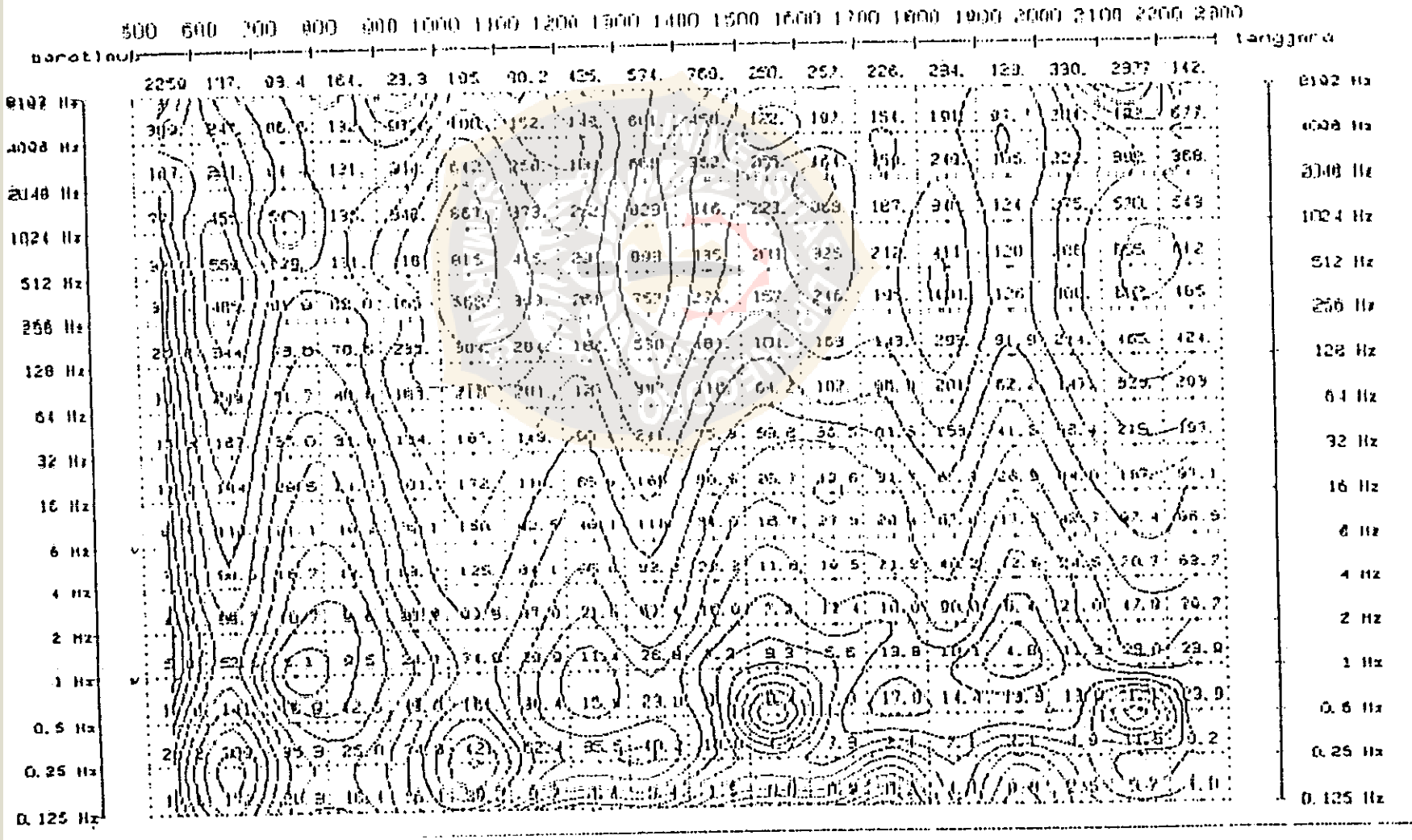
CAGNIARD RESISTIVITY

Values in Ohm-meters

RECEIVER DATA
Length = 100.0 Bipole
Spacing= 100.0m

TRANSMITTER DATA
Wavelength = 4000 m
Current = Tanggo
Distance= 8000 m
Ratio I = Time Ba

0.2150	15.8	1585
.251	25.1	(2177)
.398	39.8	
.631	63.1	
1.00	100.	
1.58	158.	
2.51	251.	
3.98	398.	
6.31	631.	
10.0	1000	



Lampiran C-3

Line C
CSAMT ZONGE
for
PERTAMINA UEP III

Field Job 002
ZONGE ZMAP 7.05
Plotted 30 Oct 94

CSAMT SURVEY DATA
CAGNIARD RESISTIVITY

Values in ohm-meters

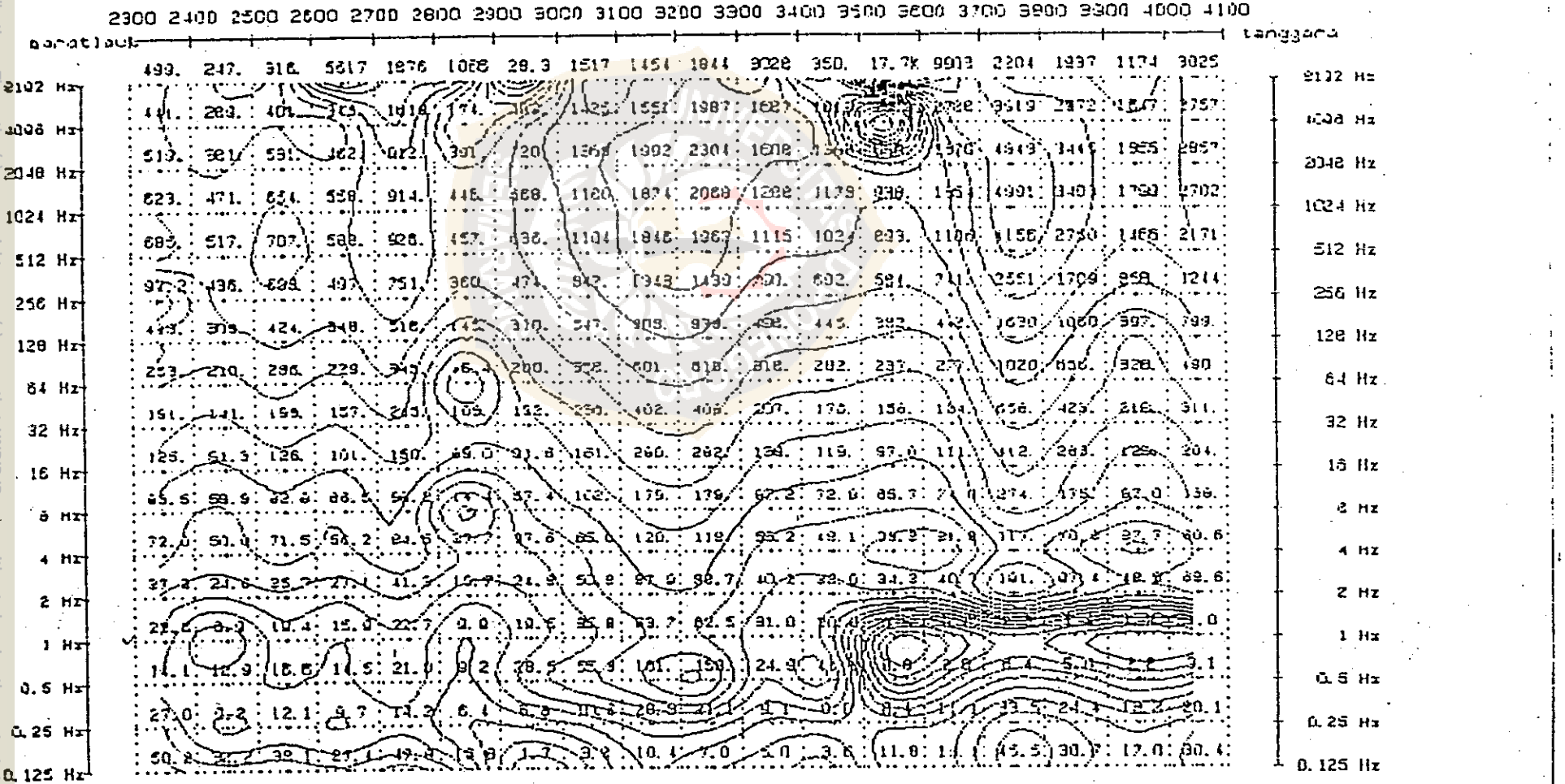
RECEIVER DATA
Length = 100.0 dipole
Spacing = 100.0m

Surveyed 20-21 Oct

TRANSMITTER DATA
Length = 4000 m
Orient. = tanggamus
Distance = 8000 m
Rx to Tx = timur laut

Plot limited and LOGARITHMIC CONTOURS
(Incr: 0.20)

1.2900	25.1	2512
.3968	50.0	5012
.6821	62.1	6310
1.00	100.	10.0k
1.58	158.	15.8k
2.51	251.	(22.3k)
3.96	398.	
6.31	631.	
10.0	1000	
15.8	1585	



Lampiran C-4

Line 0
CSAMT ZONGE
untuk
PERTAMINA UEP III

Field Job 002
ZONGE ZPLOT 7.05
Plotted 11 Oct 94

HASIL PENGUKURAN DATA RESISTIVITY

(ohm-meter)

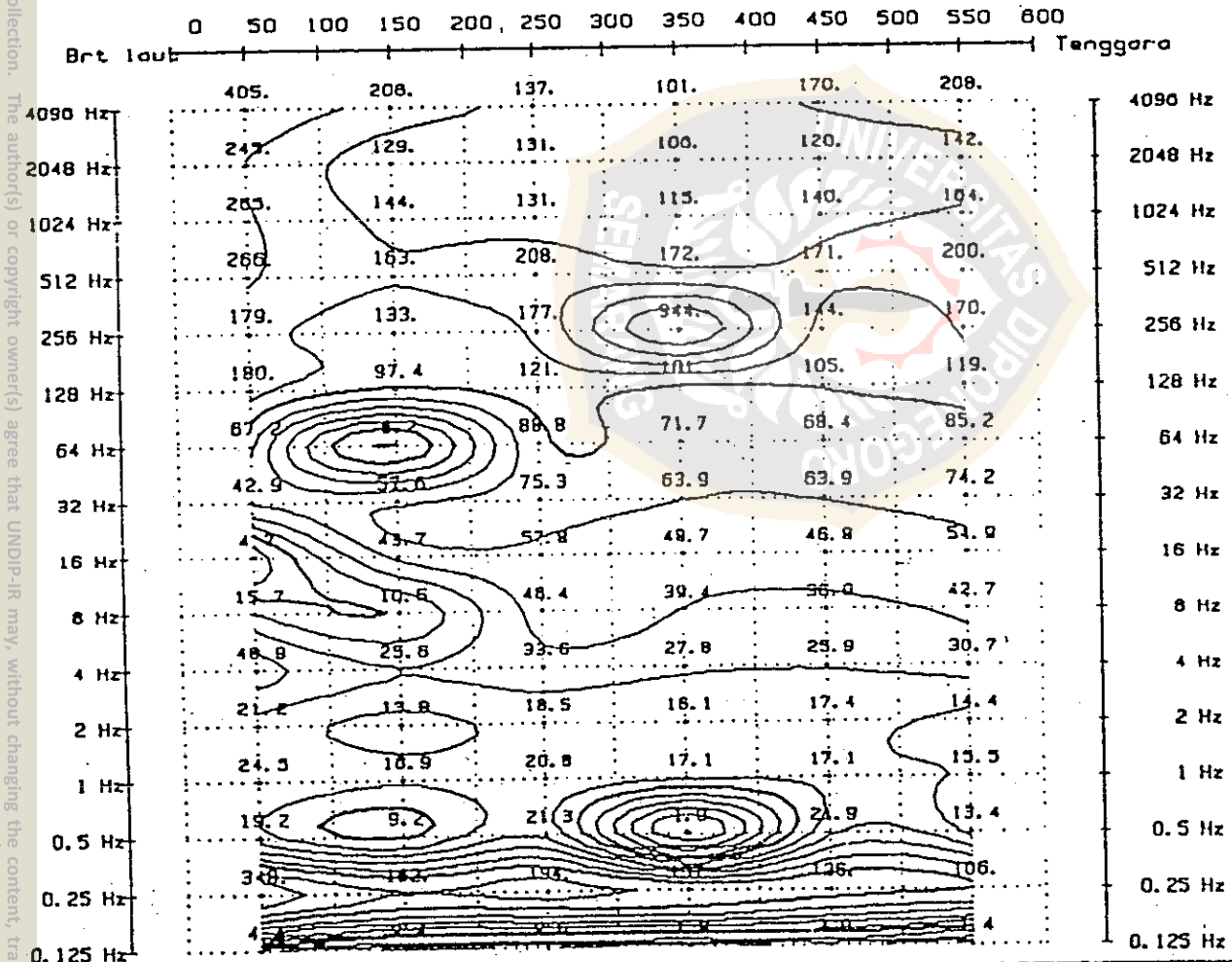
DATA RECEIVER
Panjang= 600m Lintas = Tgra
Spasi = 100 m Dipole = Tgra

Survei = 10 Okt 94

DATA TRANSMITTER
Panjang= 4000M
Orient.= Tgra
Jarak = 6500 M
Rxke Tx= Baratdaya

(Batas Plot) dan KONTUR LOGARITMA
(Interval: 0.20)

[.988]	63.1
1.00	100.
1.58	158.
2.51	251.
3.98	398.
6.31	631.
10.0	[944.]
15.8	
25.1	
39.8	



Lampiran C-5

Lintasan 0
CSAMT ZONGE
Untuk
PERTAMINA UEP III

Field Job 002
ZONGE ZPLOT 7.05
Plot 26 Oct 94

CSAMT SURVEY DATA
CAGNIARD RESISTIVITY

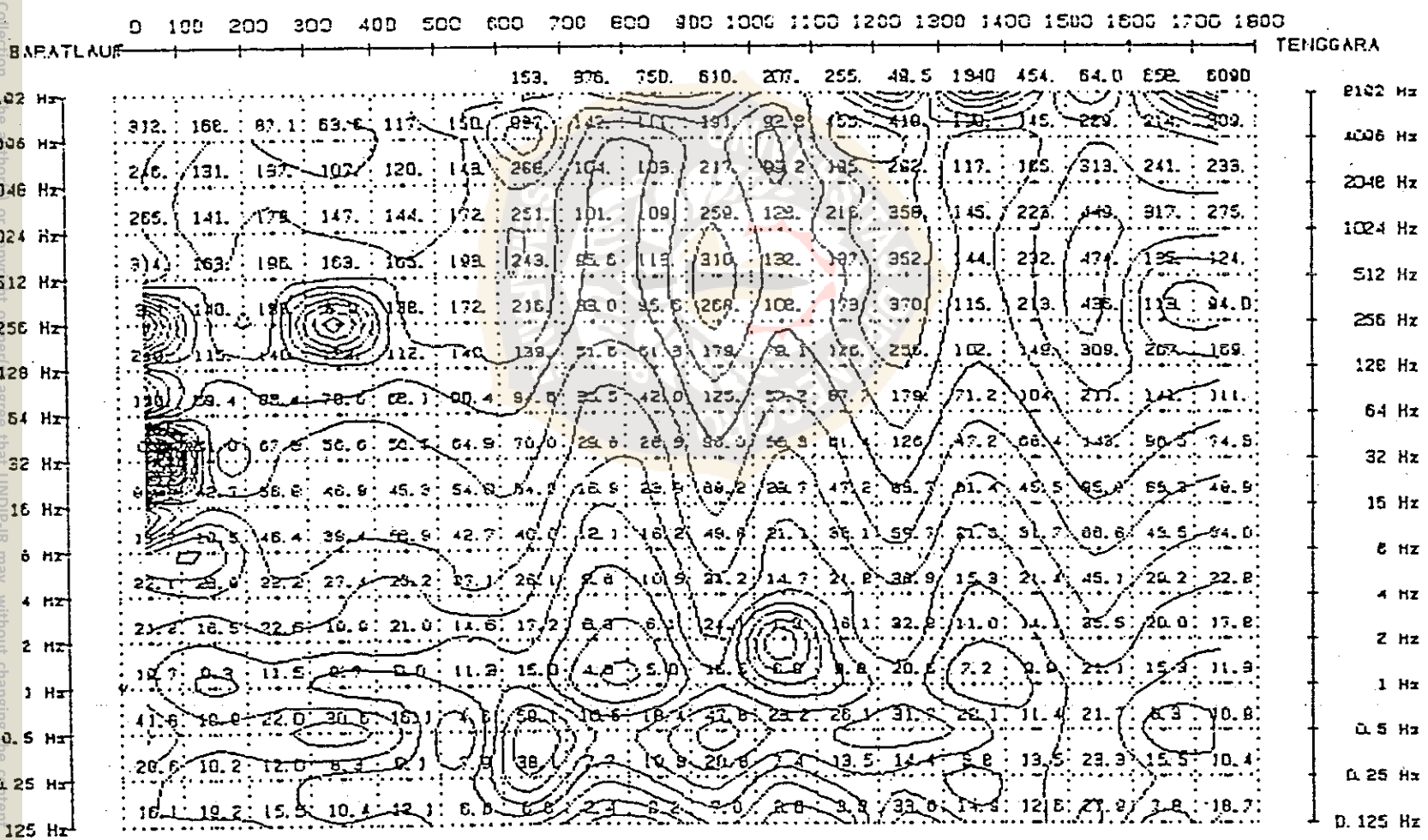
values in ohm-meters

DATA RECEIVER
Bentangan 600. (kepala- tanggul
Spasi = 100.0m
Survei = 10-12 Okt

DATA TRANSMITTER
Bentangan 4000m
Orientasi= tenggara
Jarak Tx = 6500m
Rx ke Tx = timur laut

Plot limited and LOGARITHMIC CONTOURS
(Interval: 0.20)

[152.u]	10.0m	1.00	100.
158.u	15.8m	1.58	158.
251.u	25.1m	2.51	251.
398.u	39.8m	3.98	398.
631.u	63.1m	6.31	631.
1.00m	.100	10.0	1000
1.58m	.158	15.8	1585
2.51m	.251	25.1	2512
3.98m	.398	39.8	3981
6.31m	.631	63.1	[6090



Lampiran C- 6

CSAMT ZONGE
Untuk
PERTAMINA UEP III

Field Doc 002
ZONGE ZTEM 7.05
Plot 25 Oct 94

CAGNIARD RESISTIVITY

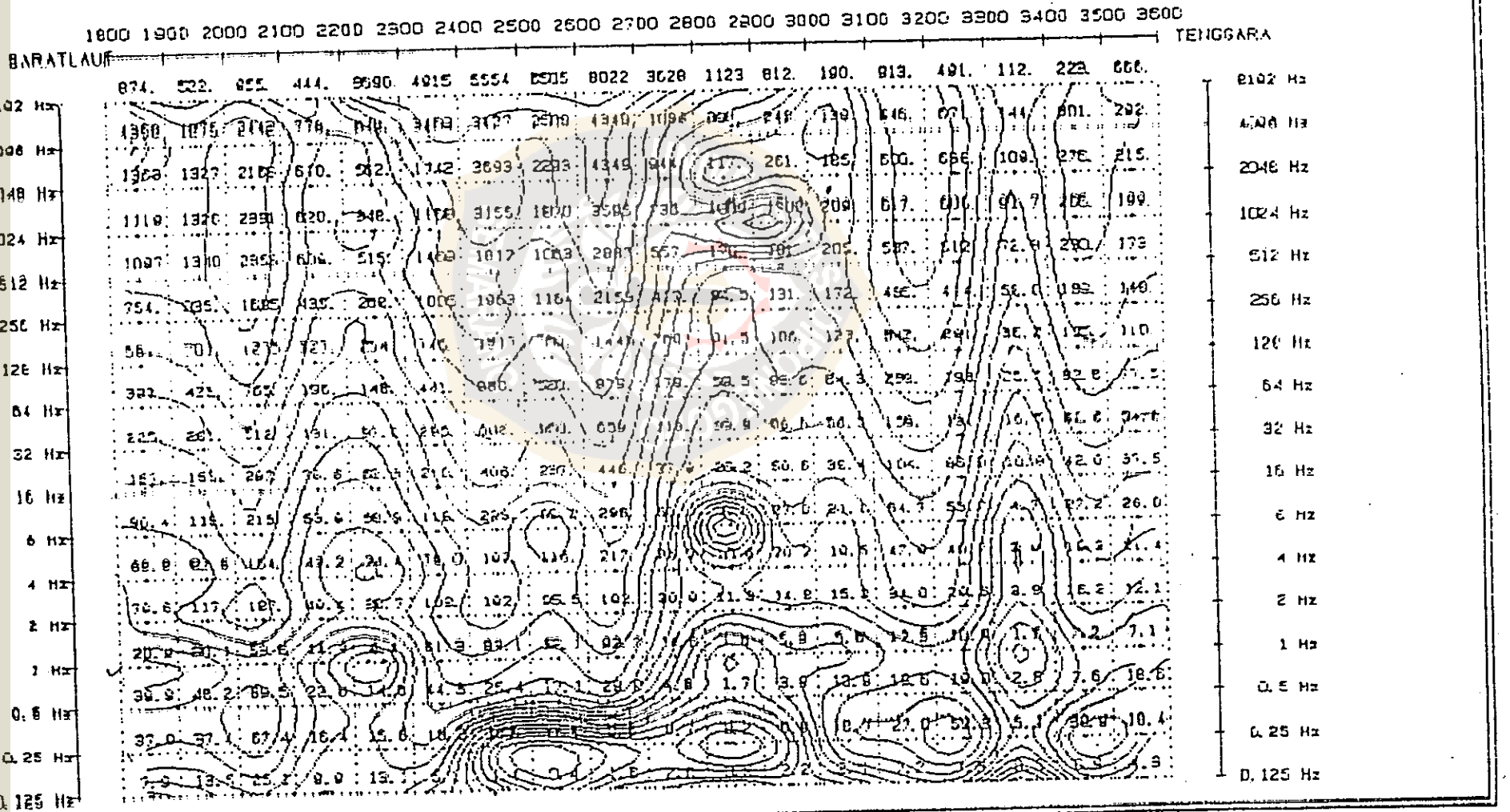
Values in ohm-meters

DATA RECEIVER:
Bentangan 6000 meter
Spasi = 100.0m

DATA TRANSMITTER
Bentangan 4000 m
Orientasi= tenggara
Jarak Tx = 6500 m
Arah Tx = timurlaut

Survai= 10-15 Okt

.251	25.1	2512
.890	89.9	8991
.631	63.1	6310
1.00	100.	10114
1.26	126.	
2.51	251.	
3.98	398.	
6.31	631.	
10.0	1000	



Lampiran C-7

Line 0
CSAMT ZONGE
for
PERTAMINA UEP III

Field Tape 002
ZONGE IPLOT 3.05
Plotted 15 Oct 84

CSAMT SURVEY DATA
CAGNIARD RESISTIVITY

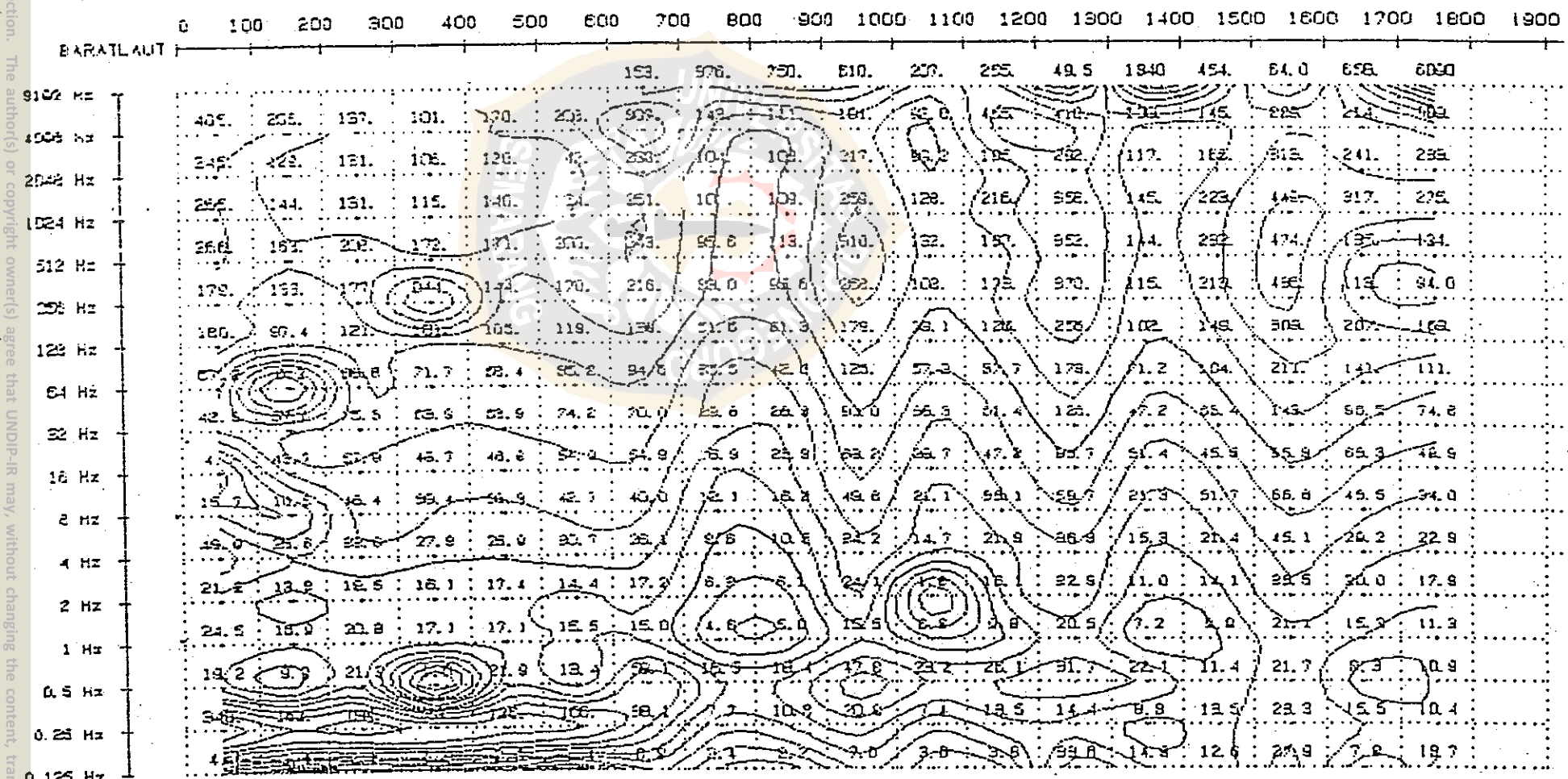
values in ohm-meters

RECEIVER DATA
Length = 100.0m Dipole= 100.0m
Spacing= 100.0m
Surveyed= 10-15 Oct

TRANSMITTER DATA
TENGGARA Length = 4000 M
Orient. = TENGGARA
Distance= 8500 M
Rx to Tx= BARATLAUT

(Plot limited and LOGARITHM
(Interval: 0.20)

[.992)	63.1
1.00	100.
1.58	158.
2.51	251.
3.98	398.
6.31	631.
10.0	1000
15.8	1585
25.1	2512
39.8	3981



Lampiran C-8

Lintasan D
CSAMT ZONGE
Untuk
PERTAMINA UEP III

Tugas Lap. 002
ZONGE ZPLOT 3.05
Plot 17 Okt 94

HASIL PENGUKURAN
DATA RESISTIVITY

(ohm-meter)

DATA RECEIVER
Panjang= 800 m Dp-Dp = Tgna
Spasi= 100 m

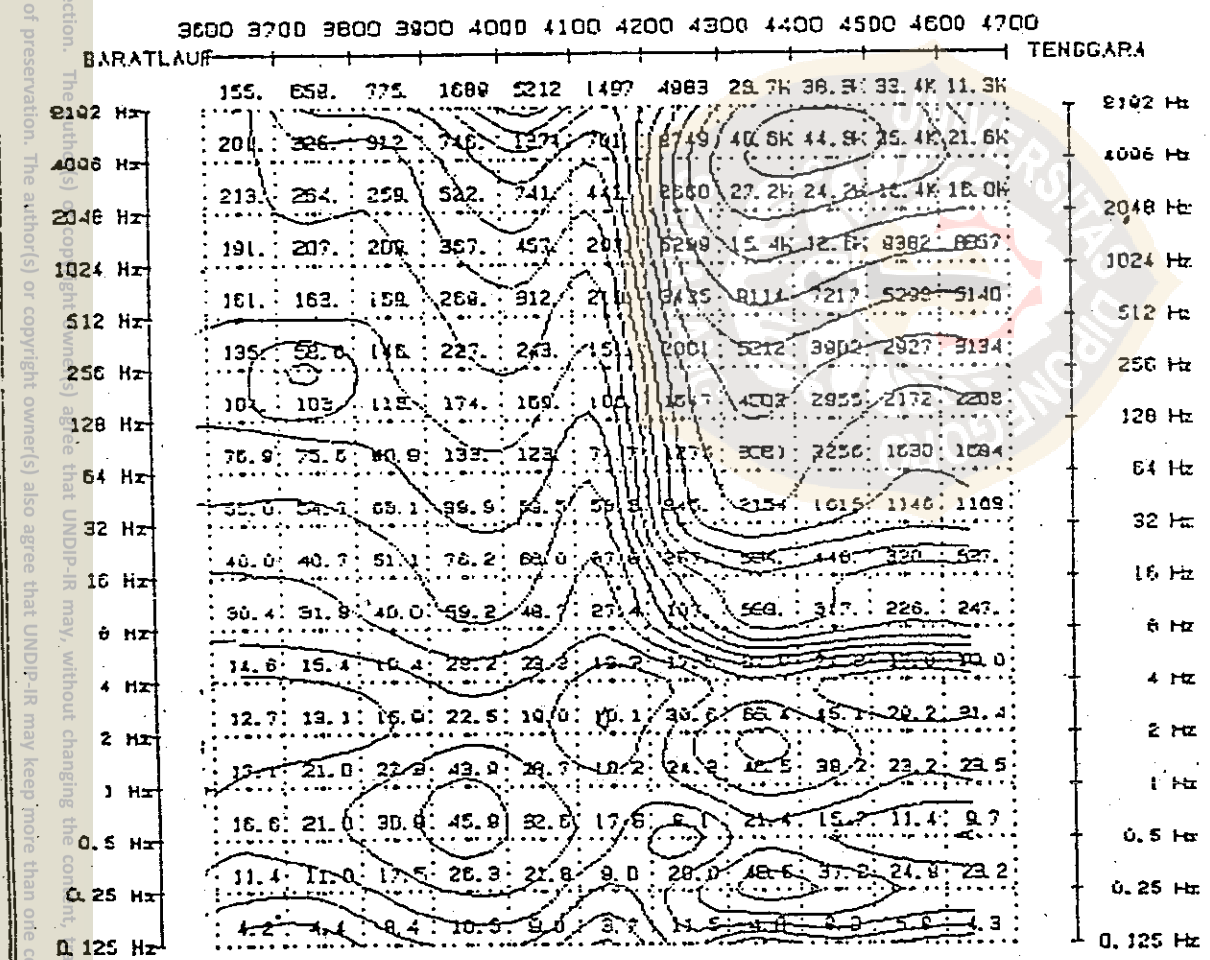
DATA TRANSMITTER
Panjang= 4000 m
Orient.= Tgna
Jarak= 6500 m

Survai= 15-17 Okt 94

Rx-Tx= Baratlaut

(Batas Plot) dan Kontur Logaritma
(Interval: 0.20)

3.980	251.	25.1K
3.98	998.	39.8K
6.31	631.	(47.1K)
10.0	1000	
15.8	1585	
25.1	2512	
39.8	3981	
63.1	6310	
100.	10.0K	
158.	15.8K	



Lampiran C-9

Line E
CSAMT ZONGE
for
PERTAMINA UEP III

Field Job 002
ZONGE TAU7 7.0E
Plotted 01 Nov 94

CSAMT SURVEY DATA
CAGNIARD RESISTIVITY

values in ohm-meters

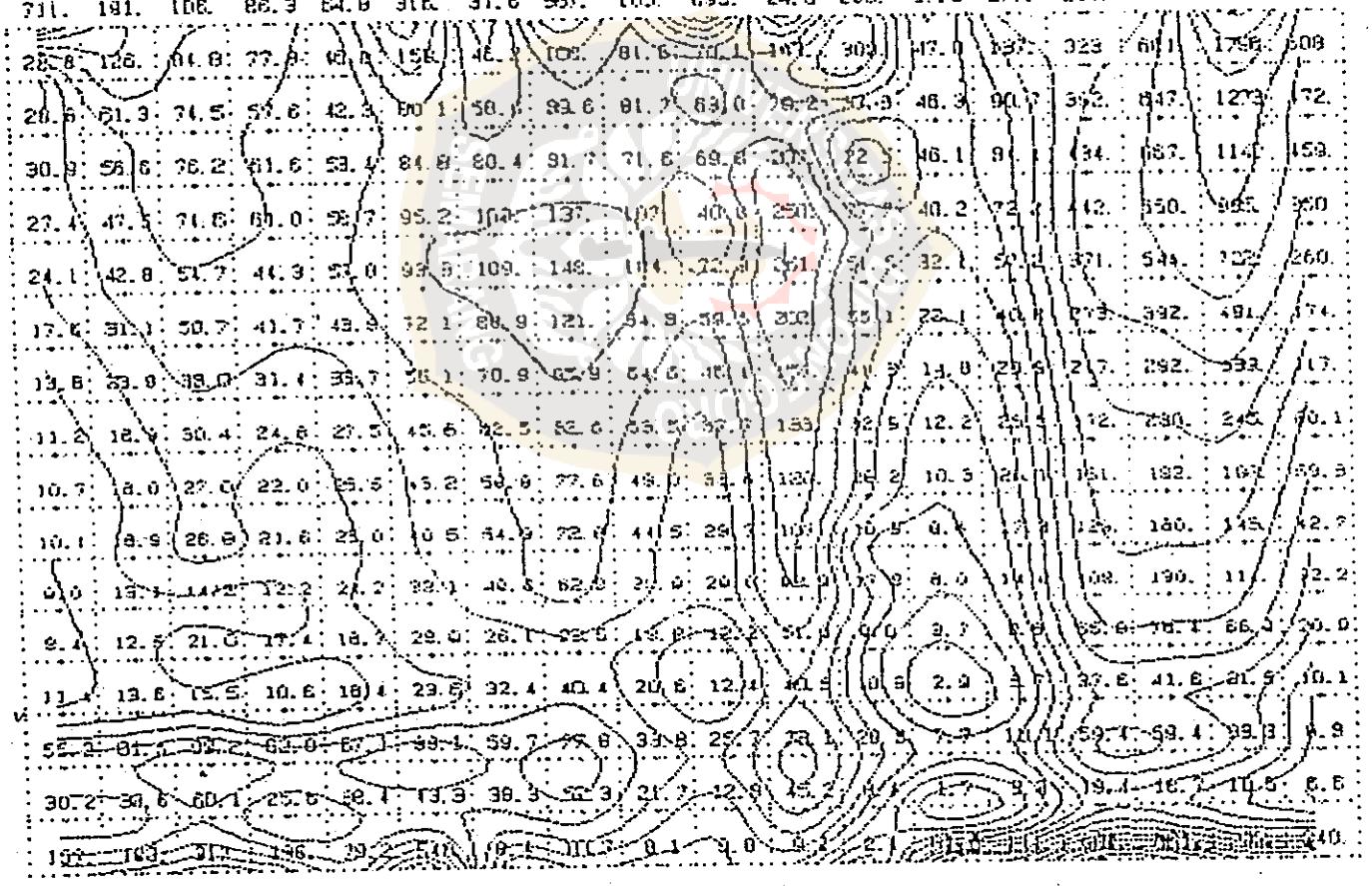
RECEIVER DATA
Length = 100.0stem - NW
Spacing= 100.0stem= SE

Survey: 22-24 Nov

TRANSMITTER DATA
Length = 4000 m
Orient. = SE
Distance= 7000 m
Rx to Tx= NE

0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800
NW SE

8192 Hz
4096 Hz
2048 Hz
1024 Hz
512 Hz
256 Hz
128 Hz
64 Hz
32 Hz
16 Hz
8 Hz
4 Hz
2 Hz
1 Hz
0.5 Hz
0.25 Hz
0.125 Hz



Lampiran C- 10

Line E
CSAMT ZONGE
for
PERTAMINA UEP III

Field Job 002
ZONGE IPLOT 7.05
Plotted 08 Nov 94

CSAMT SURVEY DATA
CAGNIARD RESISTIVITY

values in ohm-meters

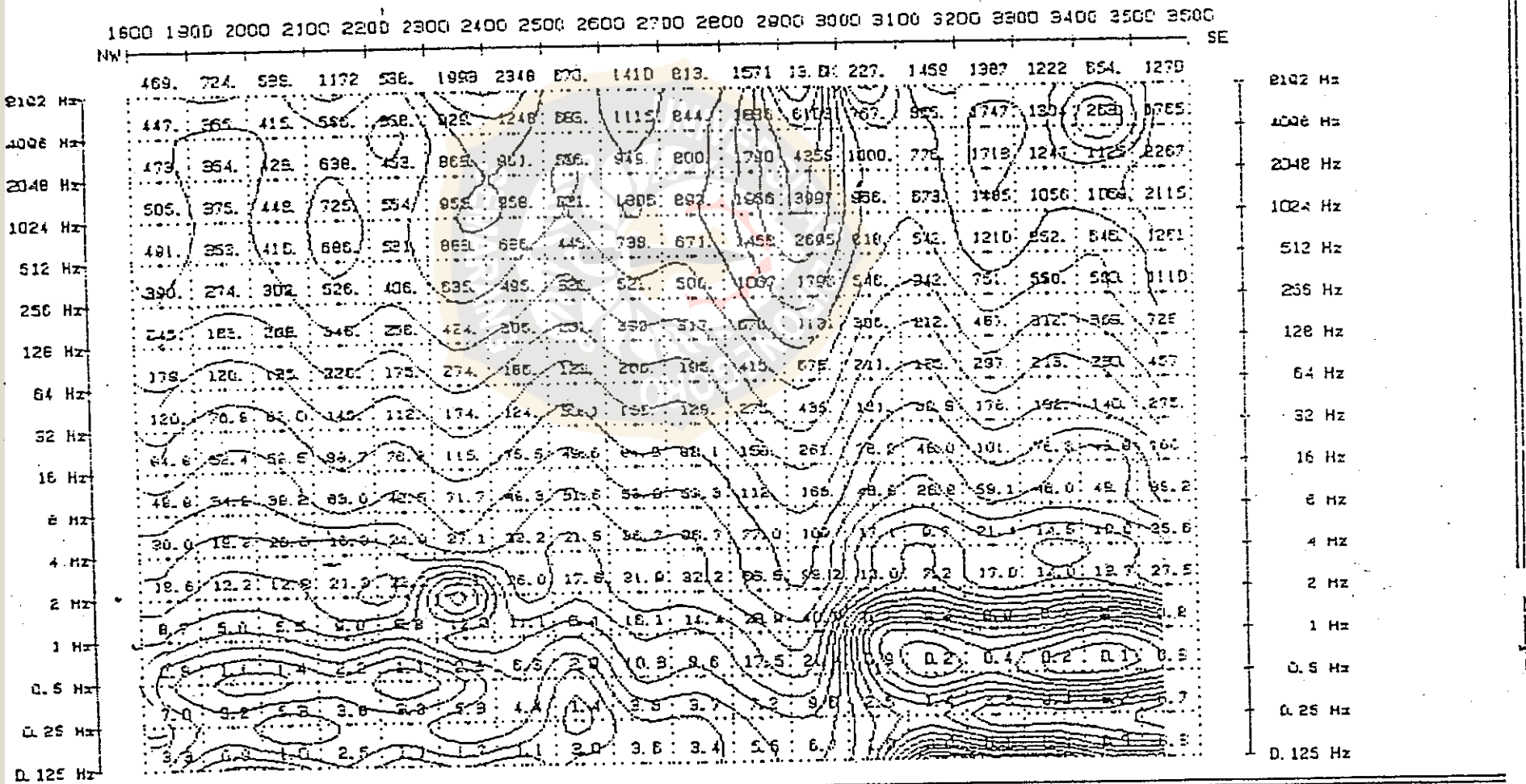
RECEIVER DATA
Length = 100.0stns = NW
Spacing= 100.0dipole= SE

Surveyed= 25 Oct 94

TRANSMITTER DATA
Length = 4000 m
Orient. = SE
Distance= 7000 m
Rx to Tx= NE

[Plot limited and LOGARITHMIC CONTOURS
((interval= 0.20)

[38.7m]	2.51	251.
39.8m	5.98	398.
63.1m	6.31	631.
.100	10.0	1000
.158	15.8	1585
.251	25.1	2512
.398	39.8	3981
.631	63.1	6310
1.00	100.	10.0K
1.58	158.	[15.8K]



Lampiran C-11

Line F
CSAMT ZONGE
for
PERTAMINA UEP III

Field Job 002
ZONGE ZPLOT 7.05
Plotted 07 Nov 94

CSAMT SURVEY DATA
CAGNIARD RESISTIVITY

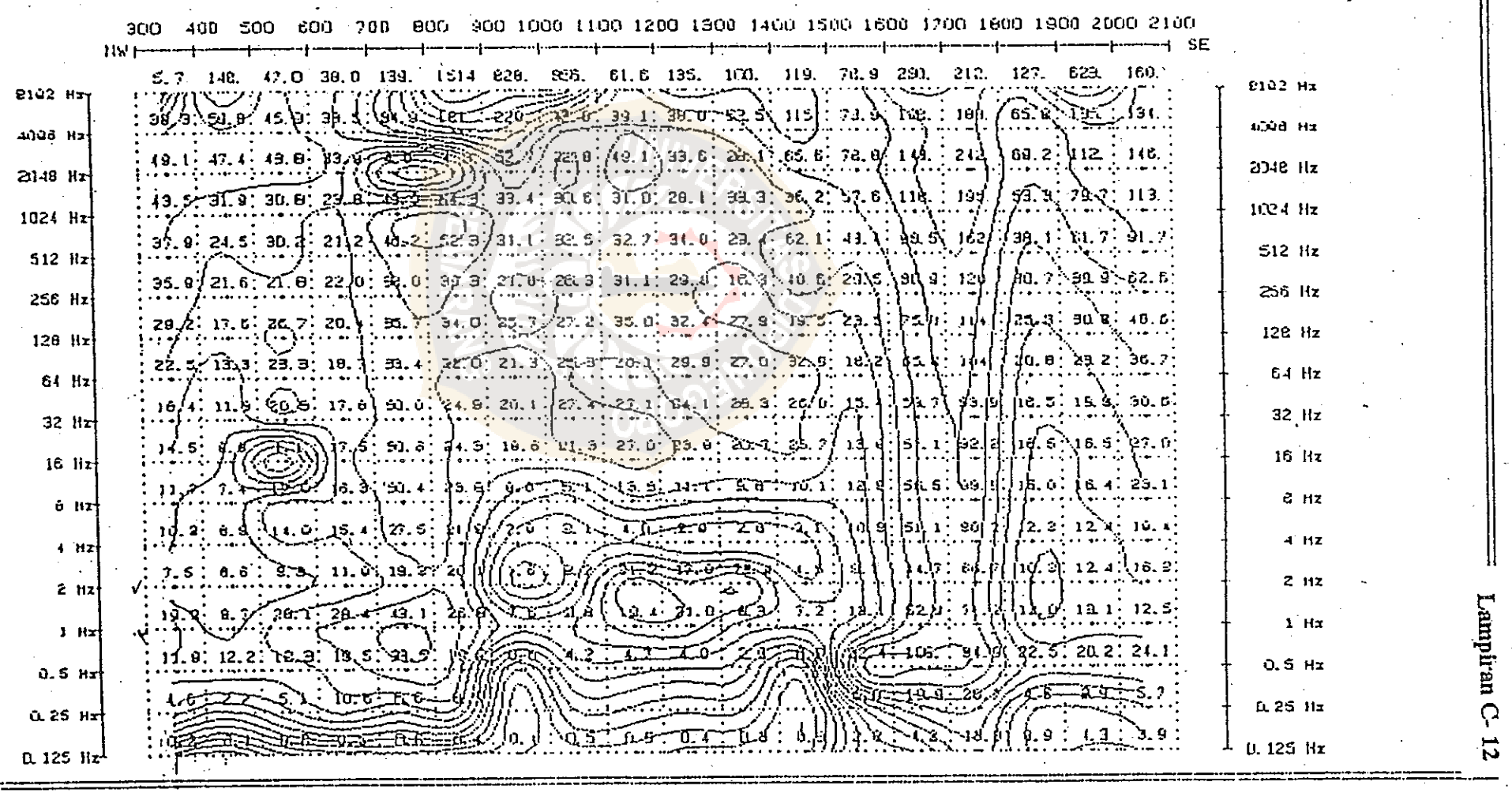
Values in ohm-meters

RECEIVER DATA
Length = 100.0 m
Spacing= 100.0 m
Surveyed= 27 Oct 94

TRANSMITTER DATA
Length = 4000 m
Orient. = SE
Distance= 7000 m
Rx to Tx= NE

(Increment: 0.20)

0.1131	10.0	1000
.158	15.8	[15781]
.251	25.1	
.396	39.8	
.631	63.1	
1.00	100.	
1.58	158.	
2.51	251.	
3.98	398.	
6.31	631.	



Lampiran C- 12

Line 1

CSAMT ZONGE
for
PERTAMINA UEP 1II

Field Job 002
ZONGE ZPLOT 7.05
Plotted 08 Nov 94

CAGNIARD RESISTIVITY

values in ohm-meters

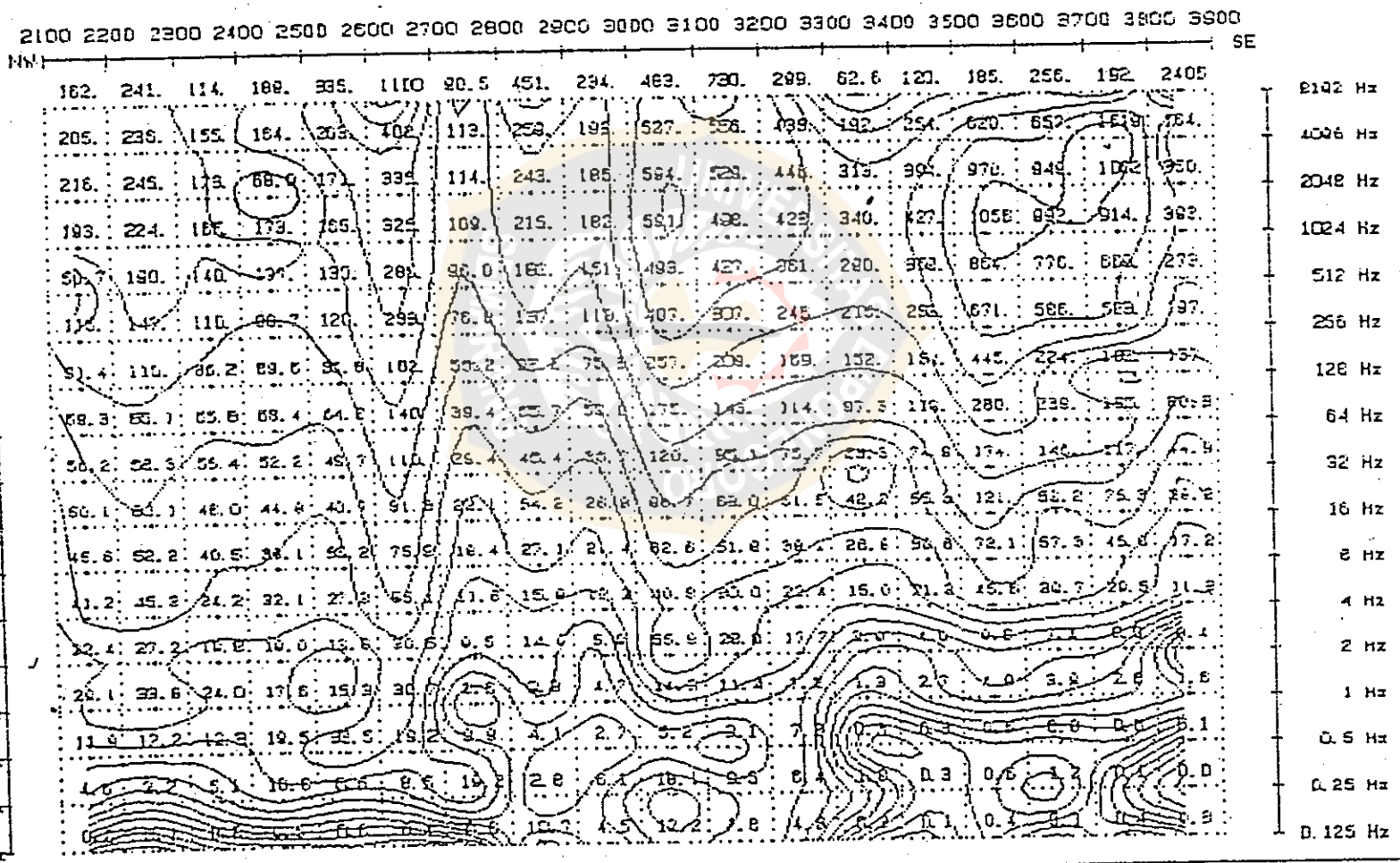
RECEIVER DATA
Length = 100.0stns = NW
Spacing= 100.0stpolen SE

Surveyed= 26-28 Oct

TRANSMITTER DATA
Length = 4000 m
Orient. = SE
Distance= 7000 m
Rx to Tx= NE

Interval: 0.20)

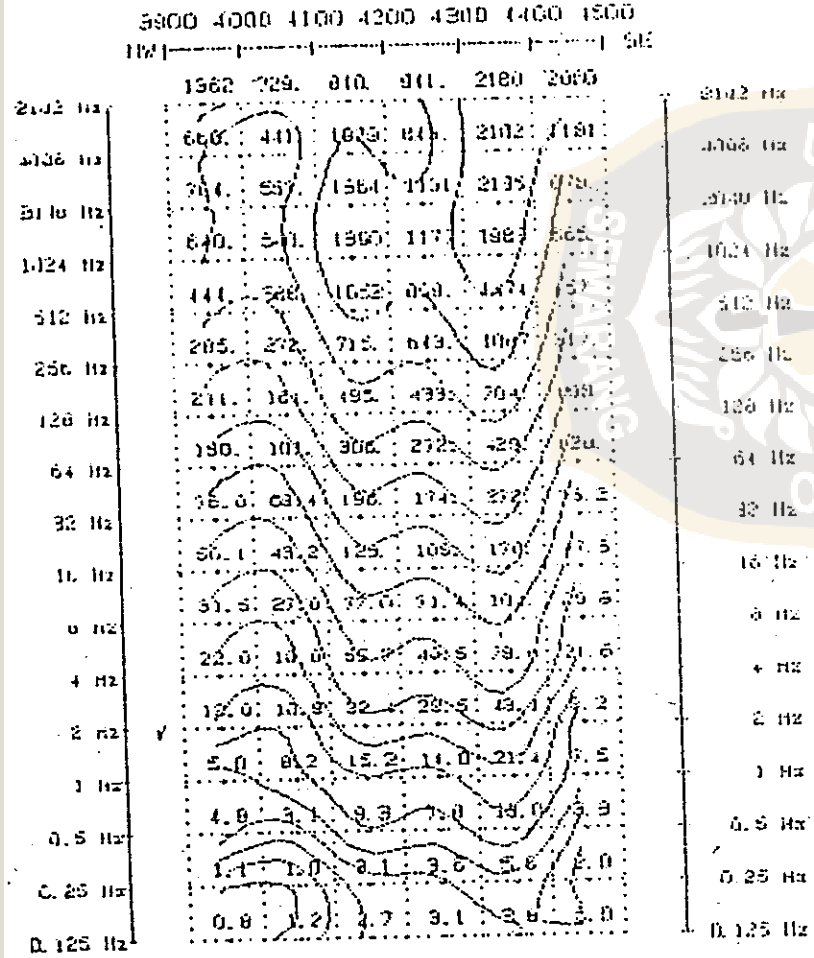
121.5m	1.58	158.
25.1m	2.51	251.
36.6m	3.98	398.
63.1m	6.31	631.
.100	10.0	1000
.158	15.8	1585
.251	25.1	(2408)
.398	39.8	
.631	63.1	
1.00	100.	



Line F
CSAMT ZONGE
for
PERTAMINA UEP III

CSAMT SURVEY DATA
CAGNIARD RESISTIVITY

values in ohm-meters



Lampiran C- 14

Line 6
CSAMT ZONGE
for
PERTAMINA UEP III

Field Job 001
ZONGE 2PLOT 7.05
Plotted 15 Nov 94

CSAMT SURVEY DATA
CAGNIARD RESISTIVITY

values in ohm-meters

RECEIVER DATA
Length = 100.0 Interval = NW
Spacings 100.0 Between = SE

Surveyed 30 Oct 94

TRANSMITTER DATA
Length = 4000 m
Orient. = SE
Distance= 7200 m
Azimuth = NE

Plot Limits and LOGARITHMIC CONTOURS
(Intervals: 0.20)
0.398 25.1 [24733]
.596 39.8
.891 62.1
1.00 100.
1.58 158.
2.51 251.
3.98 398.
5.01 501.
10.0 1000
15.8 1585

200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000
NW SE

8192 Hz
4096 Hz
2048 Hz
1024 Hz
512 Hz
256 Hz
128 Hz
64 Hz
32 Hz
16 Hz
8 Hz
4 Hz
2 Hz
1 Hz
0.5 Hz
0.25 Hz
0.125 Hz

Lampiran C-15

Line 6
CSAMT ZONGE
for
PERTAMINA UEP III

Field Job 002
ZONGE ZPLOT 2.05
Plottec 15 Nov 94

CSAMT SURVEY DATA
CAGNIARD RESISTIVITY

values in ohm-meters

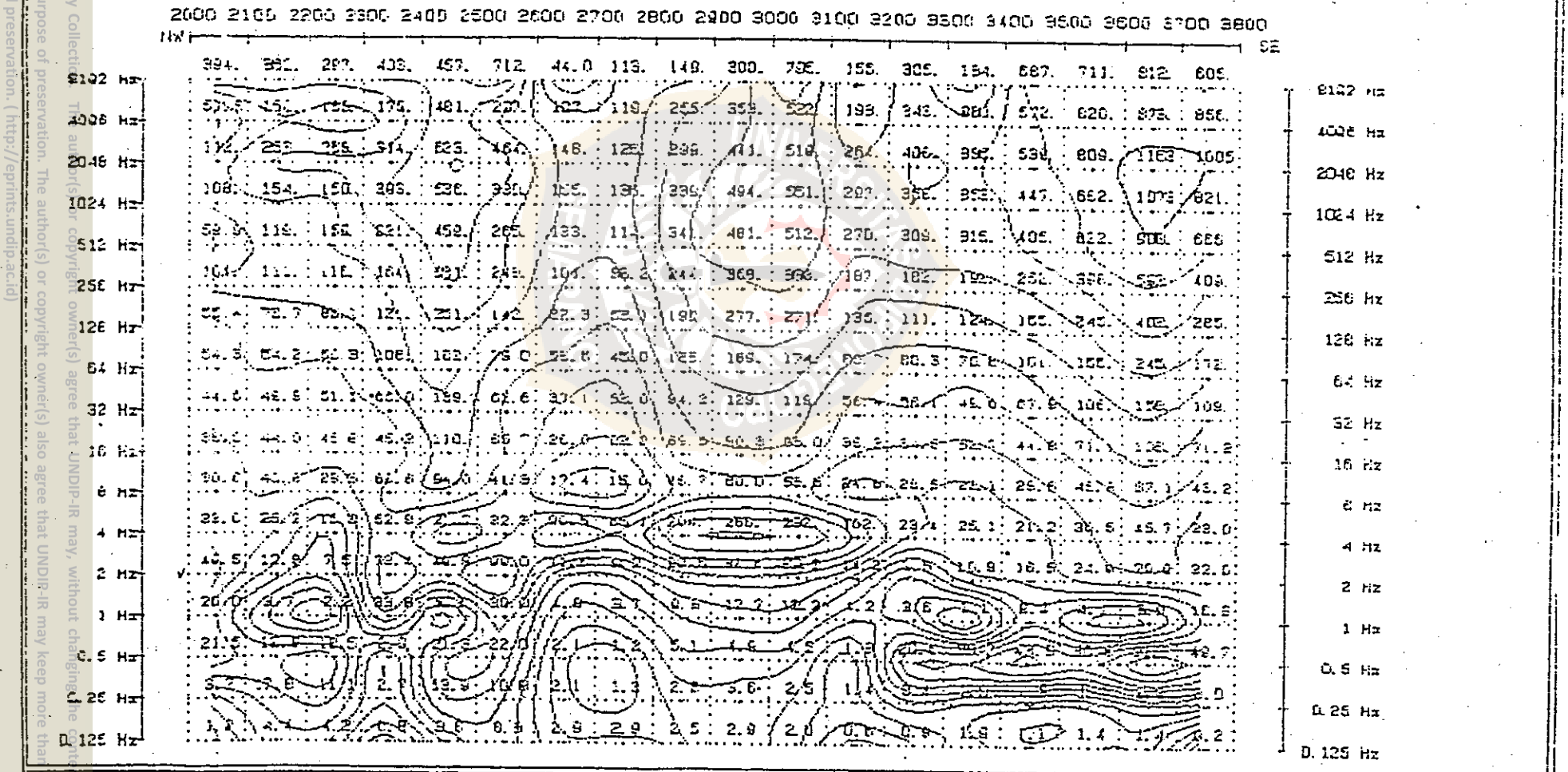
RECEIVER DATA
Length = 100.0meters - NW
Spacing= 100.0Bipolar SE

Surveyed: 01 NOV 94

TRANSMITTER DATA
Length = 4000 m
Orient. = SE
Distance= 7200 m
Polarity= NE

Plot limited and LOGARITHMIC CONTOURS
(Interval: 0.20)

0.1573	10.0	1000
.198	15.8	01107)
.251	25.1	
.396	39.8	
.251	63.1	
1.00	100.	
1.58	158.	
2.51	251.	
3.96	398.	
6.31	631.	



Lampiran C- 16

Line G
CSAMT ZONGE
for
PERTAMINA UEP III

Field Tape 002
ZONGE ZPLOT 7.05
Plotted 15 Nov 94

CSAMT SURVEY DATA
CAGNIARD RESISTIVITY

values in ohm-meters

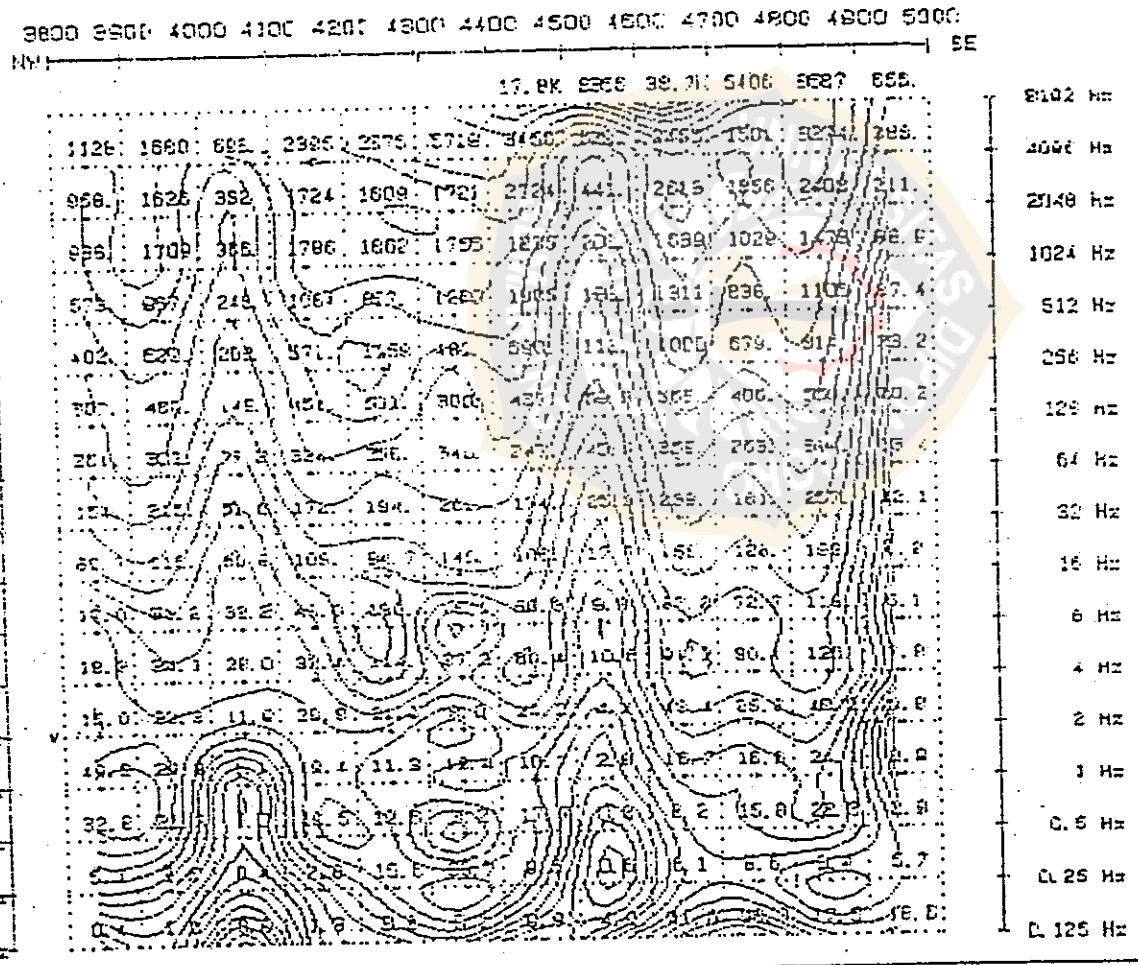
RECEIVER DATA
Length = 100. Ohm-m - NW
Spacing= 100. Ohm-m SE

Surveyed 02 NOV 94

TRANSMITTER DATA
Length = 4000 m
Orient. = SE
Distance= 7300 m
Rot to Tx= NE

Plot limited and LOGARITHMIC CONTOURS
(Increment: 0.20)

34.7m	2.51	251.	25.1K
39.8m	3.98	398.	39.8K
63.1m	6.31	631.	
.100	10.0	1000	
.159	15.8	1585	
.251	25.1	2512	
.398	39.8	3981	
.631	63.1	6310	
1.00	100.	10.0K	
1.58	158.	15.8K	



Lampiran C-17

Line H
CSAMT ZONGE
for
PERTAMINA UEP III

Field Job: 002
ZONGE IPLOT 7.05
Plottac 18 Nov 94

CSAMT SURVEY DATA
CAGNIARD RESISTIVITY

values in ohm-meters

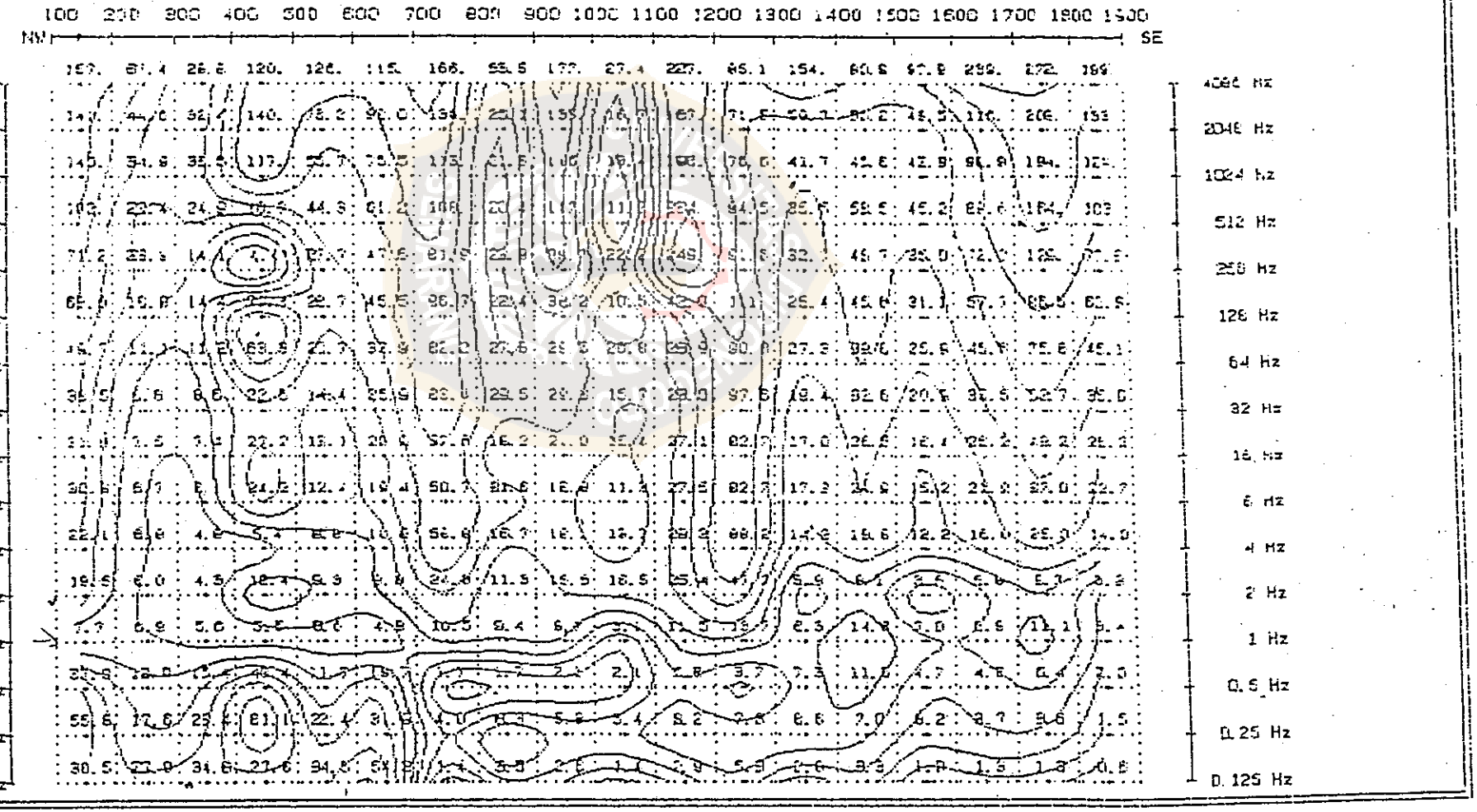
RECEIVER DATA
Length = 100.0 m Azim = NW
Spacing= 100.0 m Pole= SE

Surveyed= 07 NOV 94

TRANSMITTER DATA
Length = 4000 m
Orient. = SE
Distance= 7300 m
Far to Tx= NE

Plot Limits and LOGARITHMIC CONTOURS
(Interval: 0.20)

[634)	63.1
1.00	100.
1.58	158
2.51	251.
3.98	[304.)
6.31	
10.0	
15.8	
25.1	
39.8	



Lampiran C-18

CSAMT ZONGE
for
PERTAMINA UEP III

Field Job 008
ZONGE IP_01 7.05
Plotted 10 Nov 94

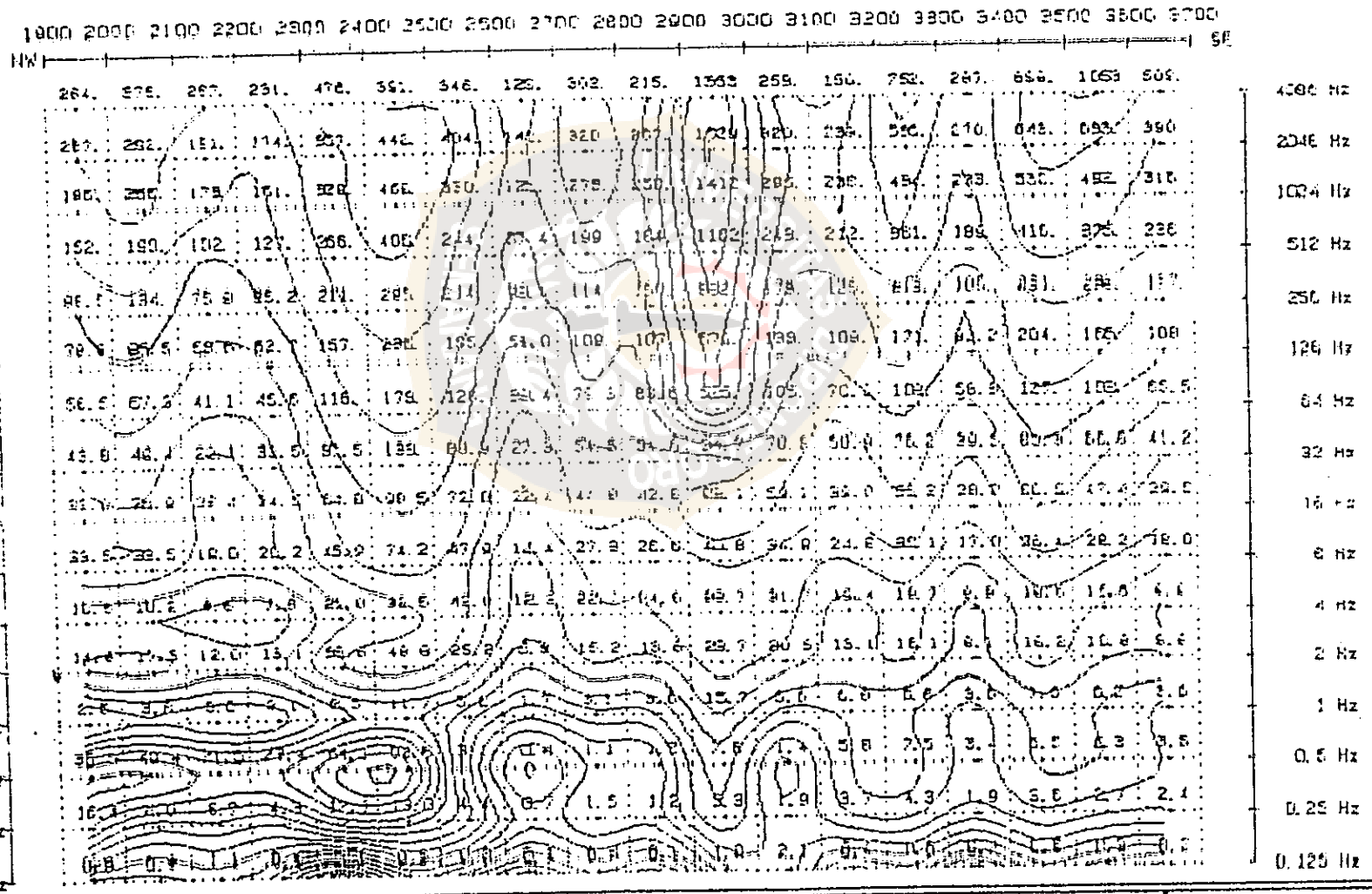
CALIFORNIA RESISTIVITY

Values in ohm-meters

RECEIVER DATA
Length = 100.0 m = N
Spacing= 100.0 m pole= SE
Surveyed= 10 NOV 94

TRANSMITTER DATA
Length = 4000 m
Orient. = SE
Distance= 7900 m
Polarity= NE

Hz	In	Ω-M
.100	10.0	1000
.158	15.8	1585
.251	25.1	(16250)
.398	39.8	
.631	63.1	
1.00	100.	
1.58	158.	
2.51	251.	



Lampiran C- 19

Line H
CSAMT ZONGE
for
PERTAMINA UEP III

Field Jan 002
ZONGE ZP_07 3.05
Plotted: 18 Nov 84

CSAMT SURVEY DATA
CAGNIARD RESISTIVITY

values in commeters

RECEIVER DATA
Length = 100.0m.ms = NW
Spacing= 100.00pole= SE

TRANSMITTER DATA
Length = 4000 m
Orient = SE
Distance= 7800 m
Polarity= NE

Linear and LOGARITHMIC CONTOURS
(INTERVALS: 0.20)

[illegible]	881.
.100	10.0
.158	15.8
.251	25.1
.398	39.8
.631	63.1
1.00	100.
1.58	158.
2.51	251.
3.98	398.

3700 3800 3900 4000 4100 4200 4300 4400 4500 4600 4700 4800 4900

NW SE

4096 Hz
2048 Hz
1024 Hz
512 Hz
256 Hz
128 Hz
64 Hz
32 Hz
16 Hz
8 Hz
4 Hz
2 Hz
1 Hz
0.5 Hz
0.25 Hz
0.125 Hz

Line K
CSAMT ZONGE
for
PERTAMINA UEP III

Field Data 6N2
ZONGE ZEN.01 7.05
Plotted 01 Nov 94

CSAMT SURVEY DATA
CAGNIARD RESISTIVITY

values in ohm-meters

DATA RECEIVER:
Dentongare 6000 meter tanggadentongare 4000 m
Spool = 100.0m
Orientasi= tanggor
Jaron Tx = 6500 m
Server= 10-15 Okt
Rotasi Tx = timurlo

Plot Interval and RESISTIVITY CONTOURS
(Interval: 100.00)
1-2073 -1900 -900. 100. 1100
-2000 -1800 -800. 200. 1200
-2000 -1700 -700. 300. 1300
-2000 -1600 -600. 400. 1400
-2500 -1500 -500 500. 1500
-2100 -1400 -400. 600. 1600
-2200 -1300 -300. 700. 1700
-2300 -1200 -200. 800. 1800
-2100 -1100 -100. 900. [1847]
-2000 -1000 0.00 1000

0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1900
NW SE

8192 Hz
4096 Hz
2048 Hz
1024 Hz
512 Hz
256 Hz
128 Hz
64 Hz
32 Hz
16 Hz
8 Hz
4 Hz
2 Hz
1 Hz
0.5 Hz
0.25 Hz
0.125 Hz

Line K
CSAMT ZONGE
for
PERTAMINA UEP III

Field Job 002
ZONGE ZPLOT 7.0E
Plotted 30 Oct 94

CSAMT SURVEY DATA
CAGNIARD RESISTIVITY

values in ohm-meters

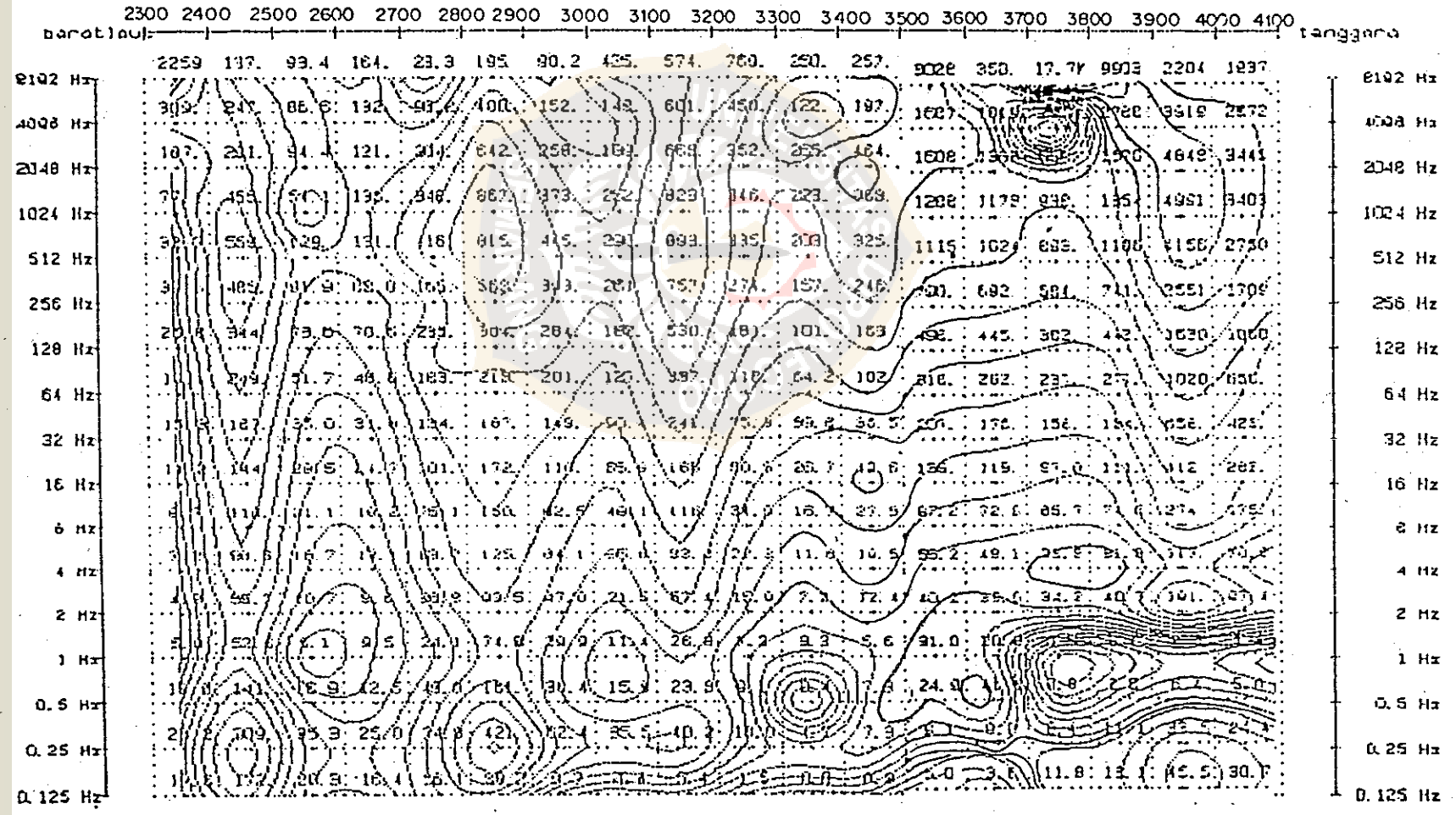
RECEIVER DATA
Length = 100.0 dipole-
Spacing= 100.0m

Surveyed= 18-19 Oct

TRANSMITTER DATA
Length = 4000 m
Orient. = tanggamus
Distance= 6000 m
Rx to Tx= timur-la

Plot Limits and LOGARITHMIC CONTOURS
(Decade: 0.20)

[.2160	15.8	1585
.251	25.1	[2377]
.398	39.8	
.631	63.1	
1.00	100.	
1.58	158.	
2.51	251.	
3.98	398.	
6.31	631.	
10.0	1000	



Lampiran C- 22

Lintasan K
CSAMT ZONGE
Untuk
PERTAMINA UEP III

Tugas Lap. 002
ZONGE ZPLOT 3.05
Plot 17 Okt 84

HASIL PENGUKURAN
DATA RESISTIVITY

(ohm-meter)

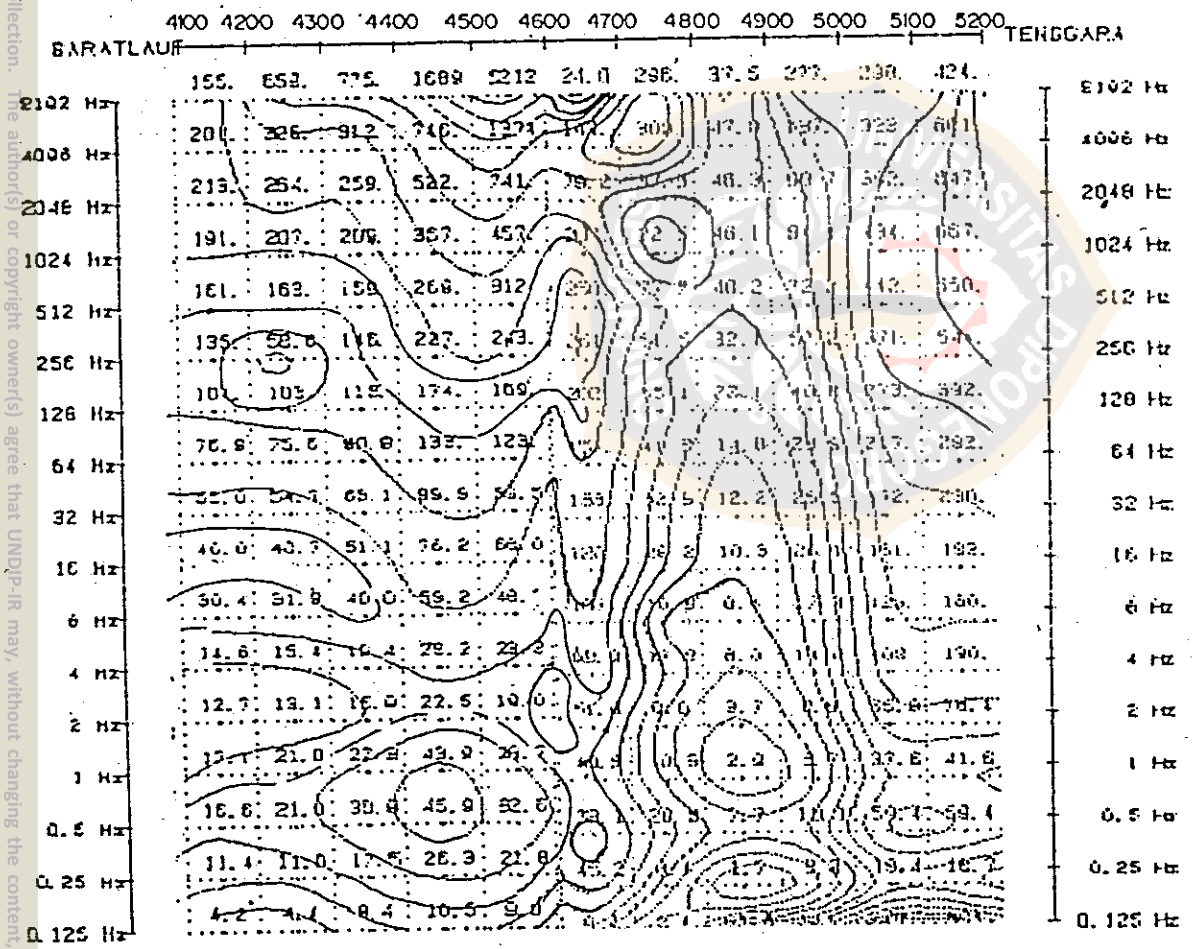
DATA RECEIVER
Panjang= 800 m Dp-Dp = Tgnh
Spasi= 100 m

Survai= 16-17 Okt 84

DATA TRANSMITTER
Panjang= 4000 m
Orient.= Tgnh
Jarak= 6500 m
Ke-Tx= Barat laut

(Batas Plot) dan Kontur Logaritma
(Interval: 0.20)

(3.000	251.	25.1K
3.08	995.	39.8K
6.31	621.	(47.1K)
10.0	1000	
15.8	1585	
25.1	2512	
39.8	9981	
63.1	6310	
100.	10.0K	
158.	15.8K	



Lampiran C- 23

Line L
CSAMT ZONGE
for
PERTAMINA UEP III

Field Job 002
ZONGE ZEUS 7.05
Plotted 30 Oct 94

CSAMT SURVEY DATA
CAGNIARD RESISTIVITY

Values in ohm-meters

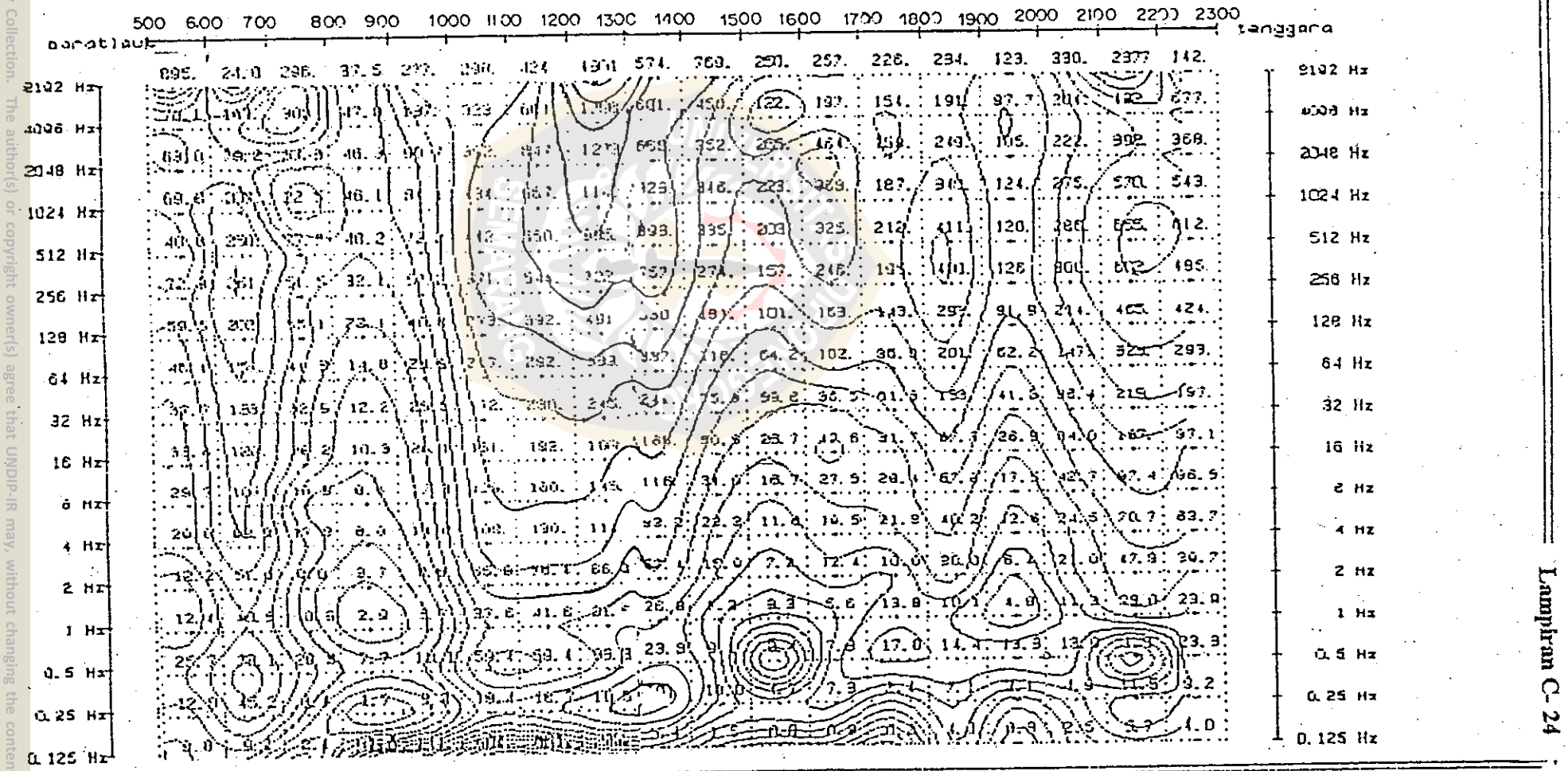
RECEIVER DATA
Length = 100.00 (pole-
Spacing= 100.0m

Surveyed: 18-19 Oct

TRANSMITTER DATA
Length = 4000 m
Orient. = tenggara
Distance= 6000 m
Rx to Tx= timurlaut

(Interval: 0.20)

0.2150	15.8	1585
.251	25.1	(2377)
.398	39.9	
.631	63.1	
1.00	100.	
1.58	158.	
2.51	251.	
3.98	398.	
6.31	631.	
10.0	1000	



Lampiran C-24

Line L
CSAMT ZONGE
for
PERTAMINA UEP III

Field Job 002
ZONGE IPLOT 7.05
Plotted 30 Oct 94

CSAMT SURVEY DATA
CAGNIARD RESISTIVITY

values in ohm-meters

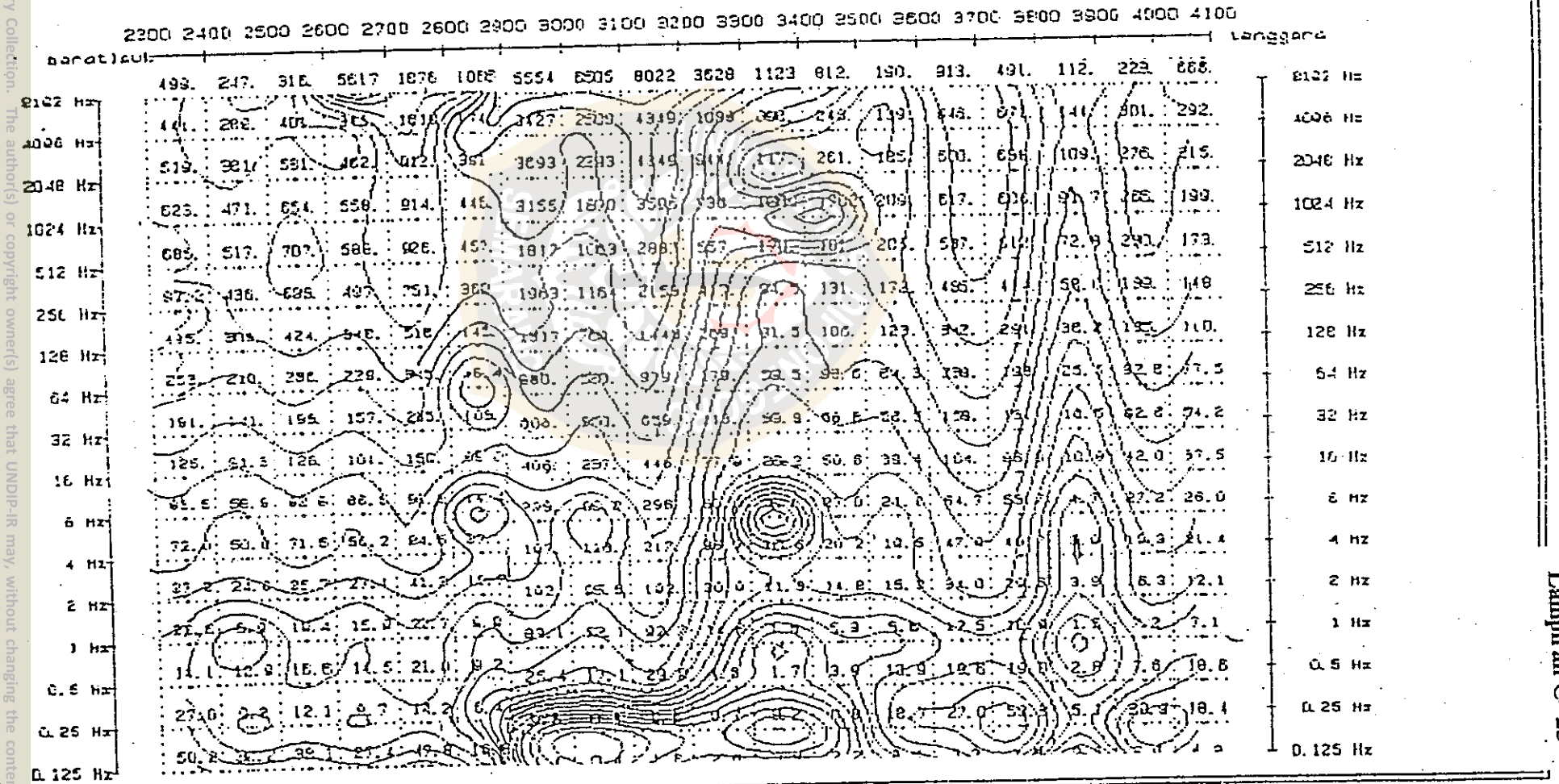
RECEIVER DATA
Length = 100.0ft dipole-
Spacing= 100.0ft

Surveyed= 20-21 Oct

TRANSMITTER DATA
tanggalength. = 4000 m
Orient. = tanggara
Distance= 6000 m
Rx to Tx= timurlaut

Plot limits: 0.20 to
Increment: 0.20

1.2900	25.1	2512
.508	39.8	3981
.691	68.1	6310
1.00	100.	10.0K
1.58	158.	15.8K
2.51	251.	[22.9K]
3.58	398.	
6.31	631.	
10.0	1000	
15.8	1585	



Lampiran C- 25

Line: M
CSAMT ZONGE
for
PERTAMINA UEP III

Field Job 002
ZONGE ZPLOT 7.15
Plotted 07 Nov 84

CSAMT SURVEY DATA
CAGNIARD RESISTIVITY

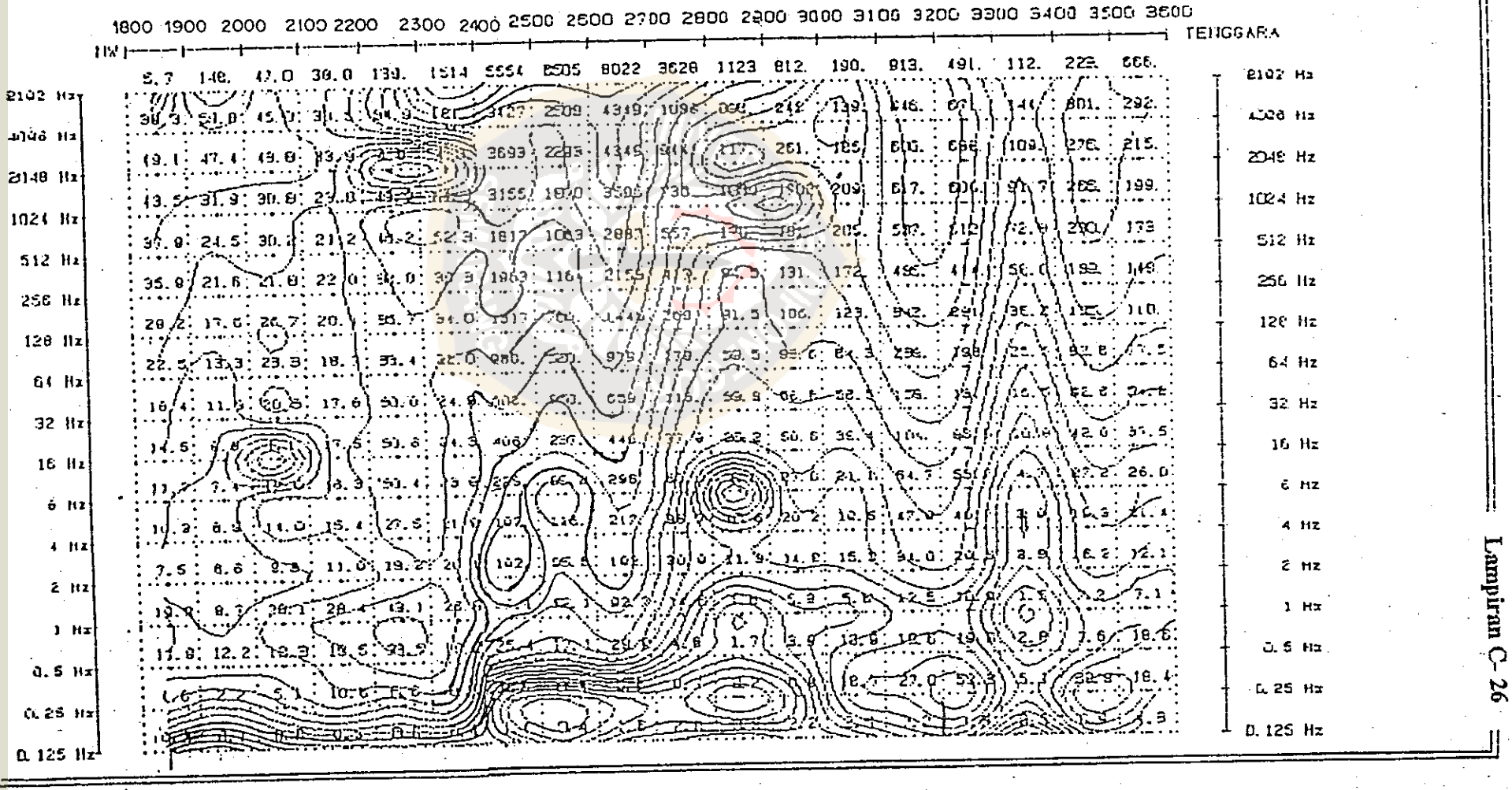
Values in ohm-meters

DATA RECEIVER
Bentengare 6000dipole- tanggBentengare 4000 m
Spool = 100.0m
Orientasi= tanggare
Jaron Tx = 6500 m
Rx no Tx = timurlo
Survei= 10-15 Okt

DATA TRANSMITTER

(Plot limits) and LOGARITHMIC CONTOURS
(Interval: 0.20)

0.1750	15.8	1585
.251	25.1	2512
.356	35.5	3981
.631	63.1	6310
1.00	100.	[3114]
1.58	158.	
2.51	251.	
3.98	398.	
6.31	631.	
10.0	1000	



Lampiran C- 26

CSAMT ZONGE
for
PERTAMINA UEP III

Plots for QC
ZONGE EPLOT 7.05
Plotted 15 Oct 94

CAGNIARD RESISTIVITY

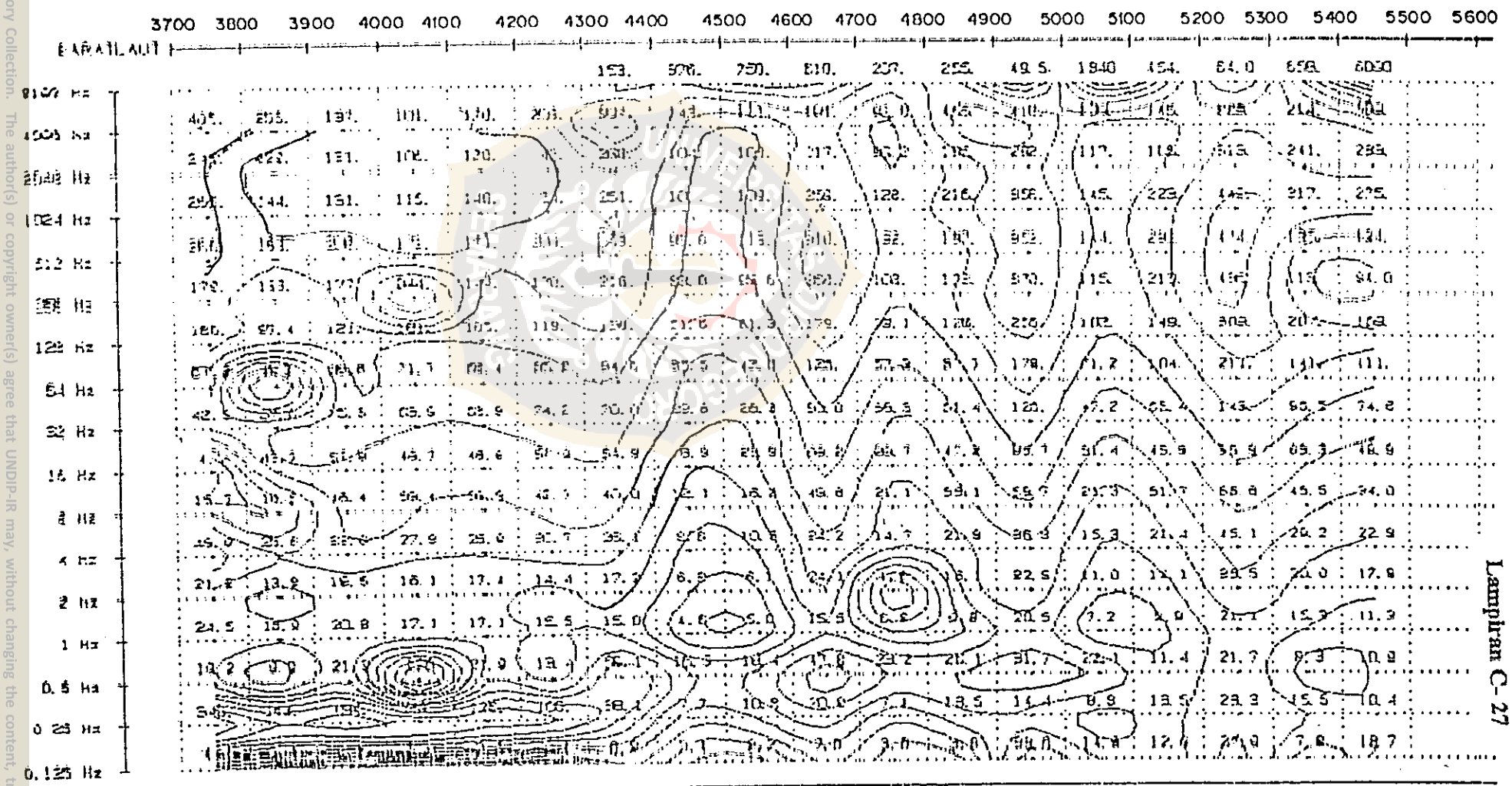
values in ohm-meters

RECEIVER DATA
Length = 100.0m Dipole-
Spacing= 100.0m

TRANSMITTER DATA
TENSOR Length = 4000 M
Orient. = TENSOR
Distance= 5000 M
Rx to Tx= BARATLAUT

Survey= 10-15 Oct

0.950	63.1
1.00	100.
1.59	158.
2.51	251.
3.98	398.
6.31	631.
10.0	1000
15.8	1585
25.1	2512
39.8	3981



Lampiran C-27

Line N
CSAMT ZONGE
for
PERTAMINA UEP III

Scale 1:20 000
ZONGE IPLOT 3.05
Plotted: 15 Oct 94

CSAMT SURVEY DATA
CAGNIARD RESISTIVITY

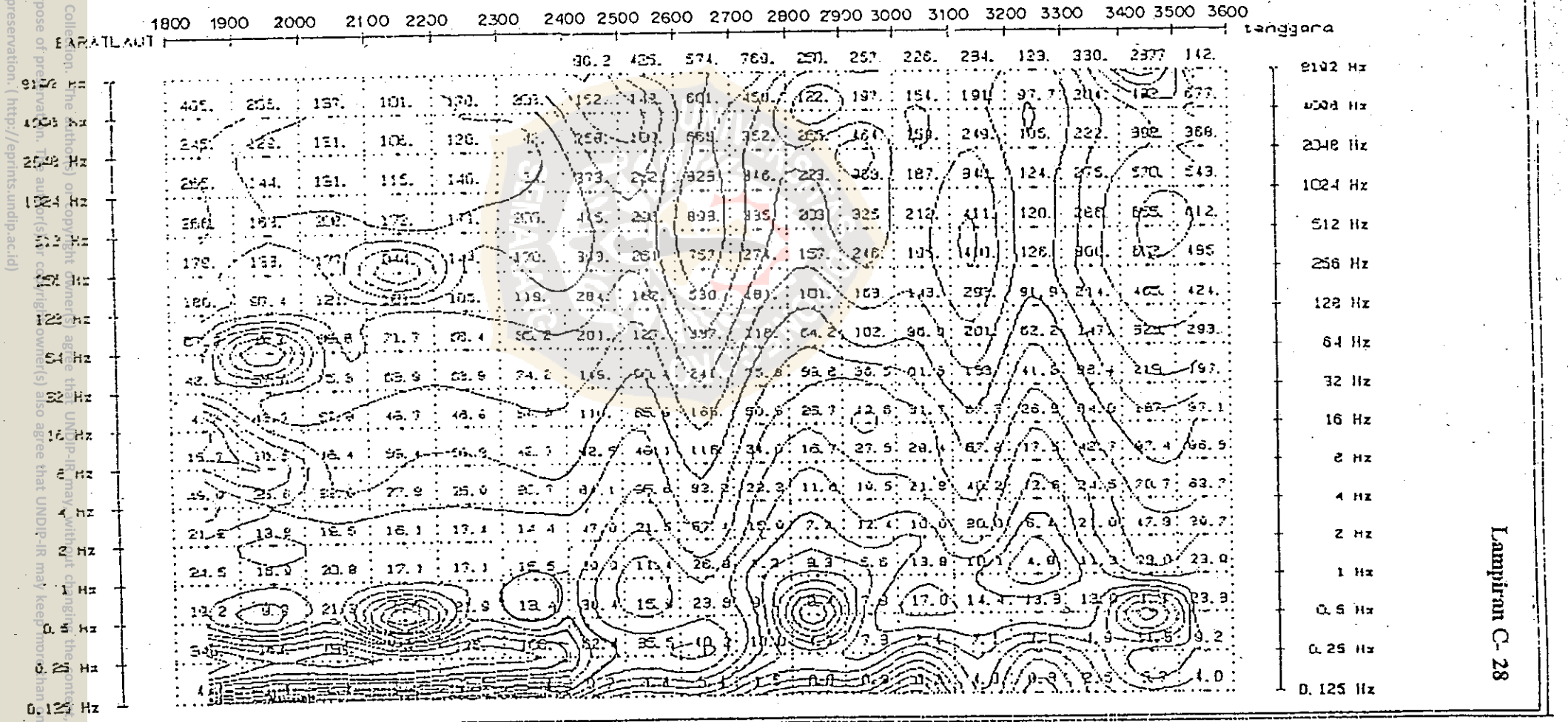
Values in ohm-meters

RECEIVER DATA
Length = 100.00 dipole
Spacing = 100.0m

Survey: 13-19 Oct

TRANSMITTER DATA
Length = 4000 m
Orient. = tenggara
Distance = 6000 m
Rx to Tx = sinuclo

Interval		
0.2160	15.8	1585
.251	25.1	(2377)
.398	39.9	
.631	63.1	
1.00	101.	
1.58	158.	
2.51	251.	
3.98	398.	
6.31	631.	
10.0	1000	



Lampiran C-28

Line N
CSAMT ZONGE
for
PERTAMINA UEP III

Field Job 002
ZONGE ZPLOT 7.05
Plotted 30 Oct 94

CSAMT SURVEY DATA
CAGNIARD RESISTIVITY

values in ohm-meters

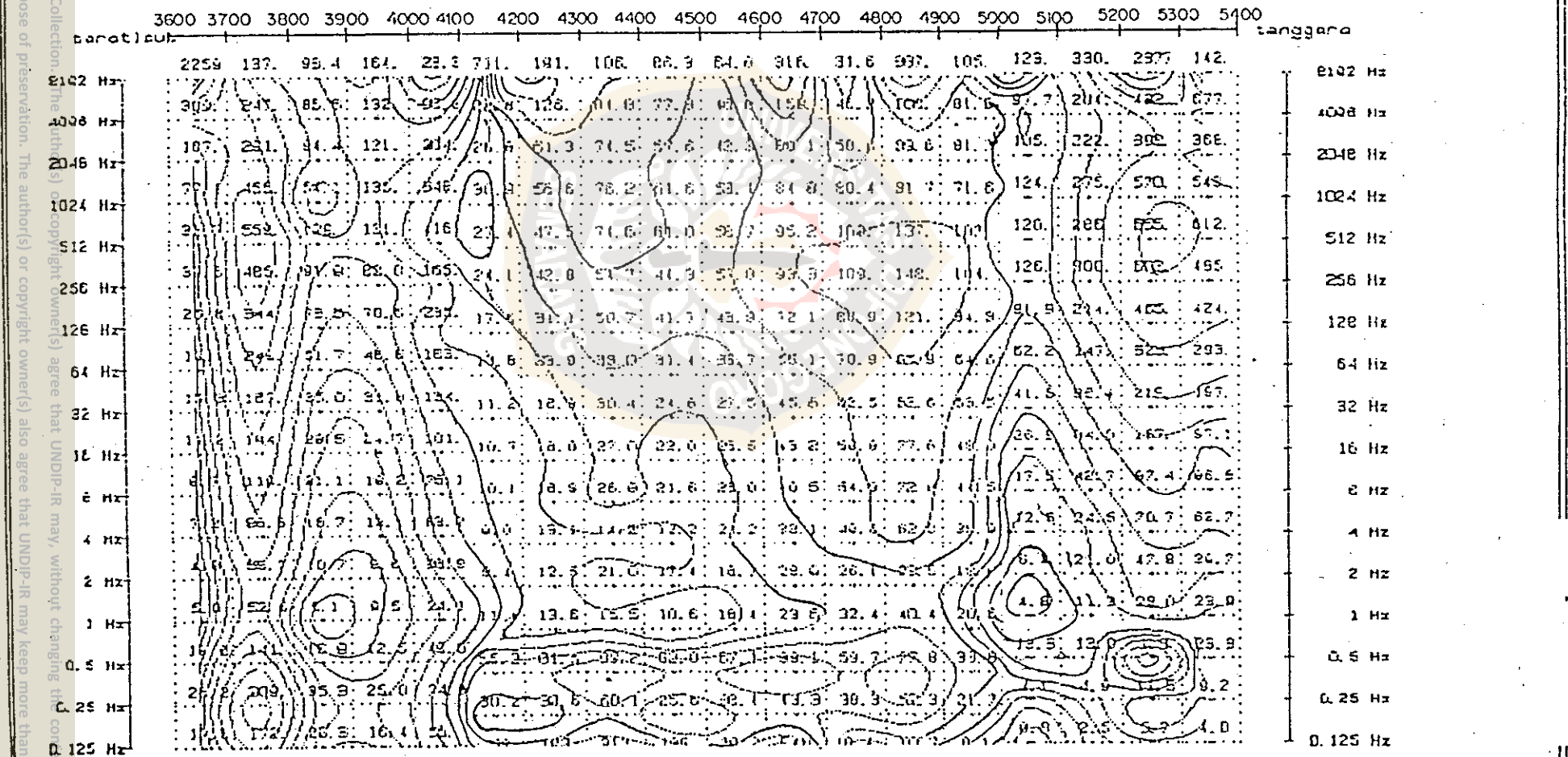
RECEIVER DATA
Length = 100.00 dipole
Spacing = 100.0m

Surveyed= 10-19 Oct

TRANSMITTER DATA
tanggalength = 4000 m
Orient. = tanggara
Distance = 6000 m
Polarity = Linear

Plot limited and LOGARITHMIC CONTOURS
(Interval: 0.20)

1.2160	15.8	1585
.251	25.1	[2377]
.398	39.8	
.631	63.1	
1.00	100.	
1.58	158.	
2.51	251.	
3.98	398.	
6.31	631.	
10.0	1000	



Lampiran C- 29

Lintasan N
CSAMT ZONGE
Untuk
PERTAMINA UEP III

Tugas Lap. 002
ZONGE INCOT 7.05
Plot 17 Okt 94

HASIL PENGUKURAN
DATA RESISTIVITY

(ohm-meter)

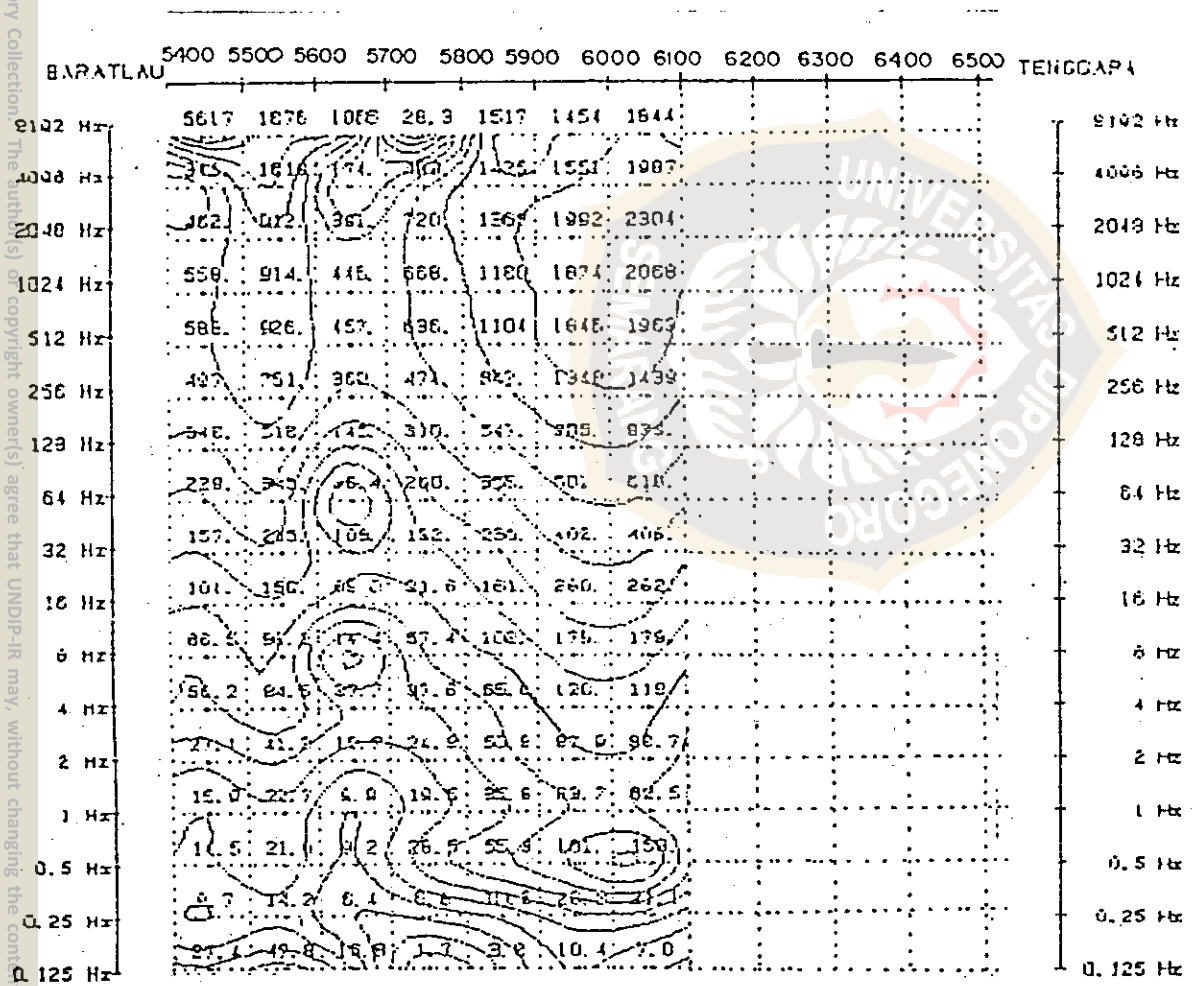
DATA RECEIVER
Panjang= 300 m Dp-Dp = Tgna
Spasi= 100 m

Survai= 10-17 Okt 94

DATA TRANSMITTER
Panjang= 4000 m
Orient.= Ygka
Jarak= 6900 m
Rx-Tx= Barat laut

(Mater Plot) dan Kontur Logaritma
(Interval: 0.20)

(3.69)	251.	25.1K
3.98	302.	31.8K
6.31	631.	(63.1K)
10.0	1050	
15.8	1525	
25.1	2512	
39.8	3981	
63.1	6310	
100.	10.0K	
139.	15.8K	

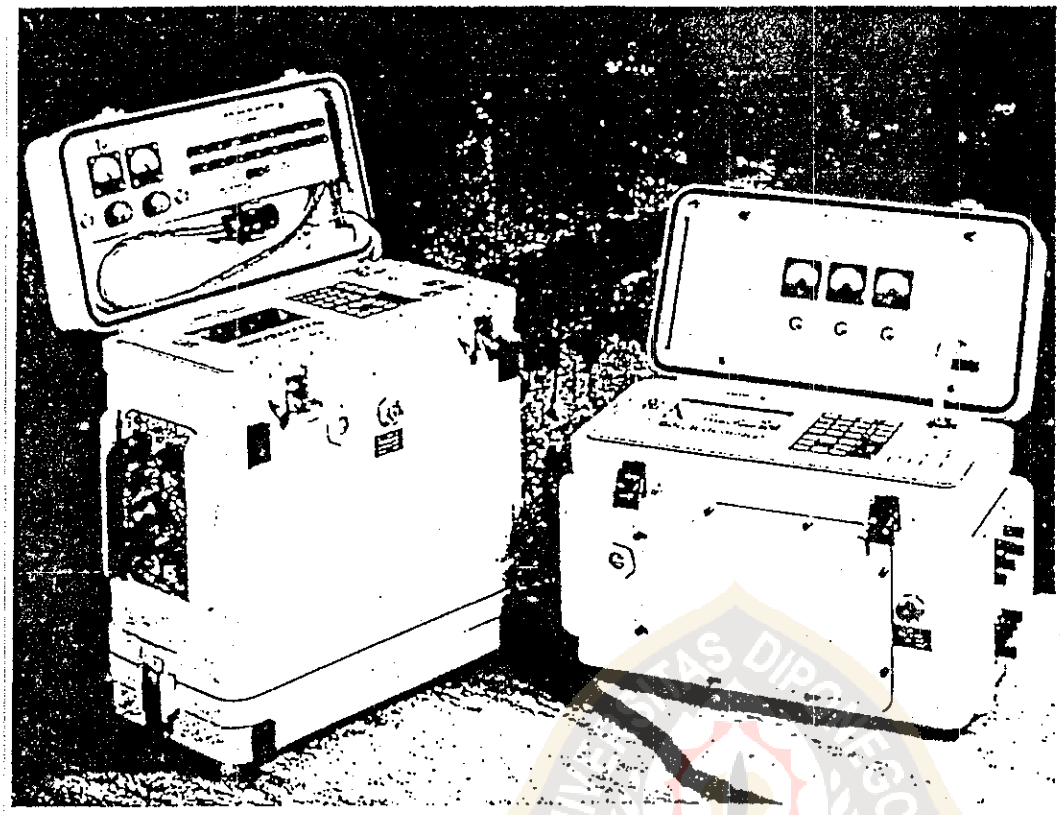


LAMPIRAN D

(PERALATAN CSAMT)

THE GDP-16
Multi-Purpose Receiver

ZONGE



FEATURES

- 1 to 8 channels, field-expandable
- 80C186 MPU, 80C187 math coprocessor
- Simple to use menu-driven software
- All programs resident in memory
- Resistivity, Time/Frequency Domain IP, CR, CSAMT, HACSAMT & TEM capability (optional AMT and MT)
- Screen-graphics: decay curves, contoured pseudosections on 256 x 128 pixel LCD
- Use as a data logger for analog data, borehole depth data, etc.
- 0.001 Hz to 8 kHz frequency range (standard)
- One 16 bit A/D per channel for speed & phase accuracy
- 256 KB ROM, 256 KB RAM for program execution
- 896 KB RAM for data storage standard, stores several days' worth of data—non-volatile RAM expansion up to 6 MB
- Real-time data & statistics display
- Anti-alias, powerline notch & telluric filtering
- Automatic SP buckout, gain setting & calibration
- Rugged, portable & environmentally sealed
- Modular design for easy upgrades & board replacement
- In-field data processing on a personal computer
- Complete support: field peripherals, service network, software, training
- Easy to use menu-driven software

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SPECIFICATIONS: GDP-16 MULTI-PURPOSE RECEIVER

General

Description: Broad-band, multi-channel, multi-function, digital receiver
Frequency range: 0.001 Hz to 8 kHz (standard)
Number of channels: 1 to 8 (field expandable)
Survey capabilities:
- Resistivity
- Time domain IP
- Frequency/phase domain IP
- Complex resistivity
- CSAMT (scalar, vector, tensor)
- Harmonic CSAMT
- Frequency domain EM
- Transient electromagnetics (TEM)
- Magnetotellurics (MT, AMT)
- Other user-programmed functions

Software language: C and assembly
Size:
- Large case:
  41 x 20 x 45 cm (16 x 8 x 17.5 in)
- Small case:
  41 x 20 x 31 cm (16 x 8 x 12 in)

Weight: (including batteries and meter/connection panel):
- Large case:
  - 8-channel, 20 kg (43.5 lb)
  - 8-channel, large battery pack, 23.4 kg (51.5 lb)
- Small case:
  - 3-channel, 14.3 kg (31.5 lb);

Enclosure: Heavy-duty, environmentally-sealed aluminum case
Power: 12 V rechargeable batteries in removable battery pack (field-replaceable without loss of synchronization). Over 10 hours nominal operation at 20°C with 8 channel unit; additional batteries mounted internally or external battery input for extended operation in cold climates.
Temperature range: −40° to +60°C (−40° to +140°F)
Humidity range: 5% to 100%; operable in direct rain
Time base: Oven-controlled crystal oscillator; aging rate $<5 \times 10^{-10}$ per 24 hours

Displays & Controls

LCD alphanumeric/graphics display, 41 characters by 16 lines, with continuous view-angle adjustment, optional heater for use down to −40°C.
Sealed keyboard with 10 numeric and 25 function keys
Analog signal meters and analog outputs
Crystal on-off
Crystal adjust

Analog

Input impedance: 10 MΩ at DC
Dynamic range: 180 dB
Minimum detectable signal: .03 μV
Maximum input voltage: ±32 V
DSP offset adjustment: ±2.5 V in 76 μV steps (automatic)
Automatic gain setting in binary steps from 1/8 to 65,536
Input: True differential for common-mode rejection
Phase Accuracy, ±0.1 milliradian (0.006 degree)
Adjacent channel isolation at 100 Hz: >90 db

Filter Section

Four-pole Bessel anti-alias filter (software-controlled)
Quadruple-notch, specified by user (e.g., 50/150/250/450 Hz, 50/150/60/180 Hz, 60/180/300/540, etc.)
Digital telluric filter

Analog to Digital Converter

Resolution: 16 bits ±1/2 LSB
Conversion time: 17 μsec
Continuous self calibration
One A/D per channel for maximum speed and phase accuracy

Digital Section

Microprocessors: 80C186 with 80C187 math coprocessor
NEC V40 for keyboard, LCD display and I/O control
Memory: 256 KB ROM, 256 KB RAM for program use; 896 KB RAM data storage (standard)
Memory Expansion: 1.5 MB increments to 6 MB
On-board calendar clock
Serial ports: Two RS-232 ports
Parallel port: Two IBM/Centronics compatible printer ports one standard, one bi-directional

Options

Number of channels (between 1 and 8)
RAM disk for extended data storage
High-precision rubidium crystal oscillator with aging rates of $\leq 5 \times 10^{-11}$ per month
External battery and LCD heater for −40° operation
IR filter for LCD

Specifications subject to change without notice.

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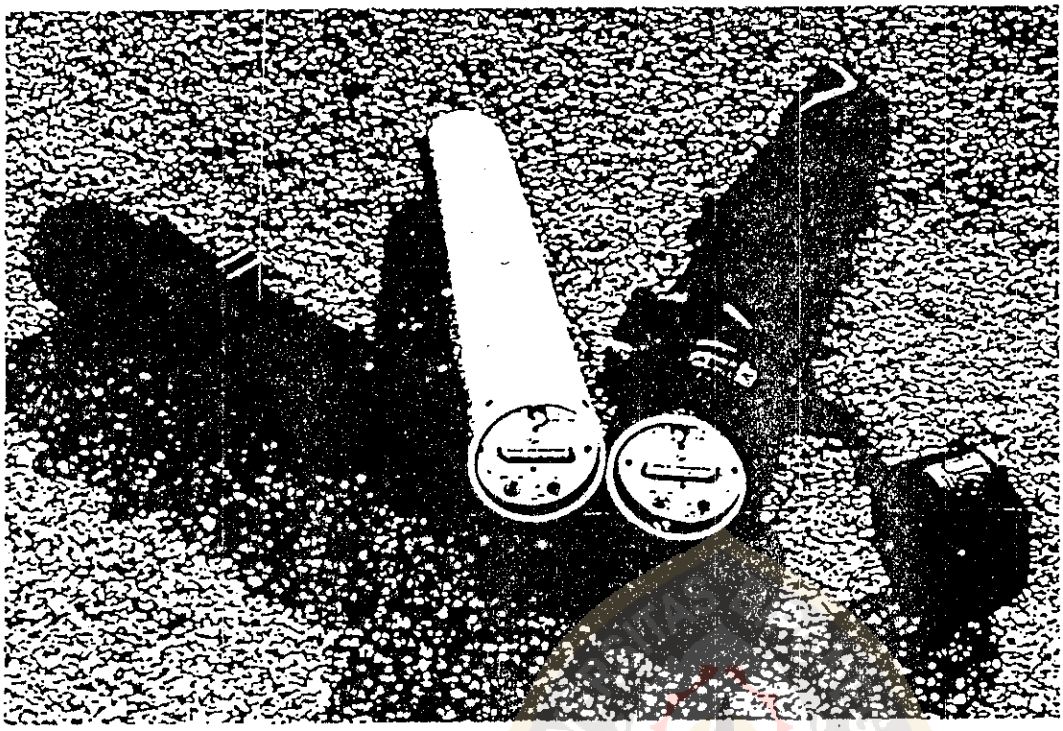
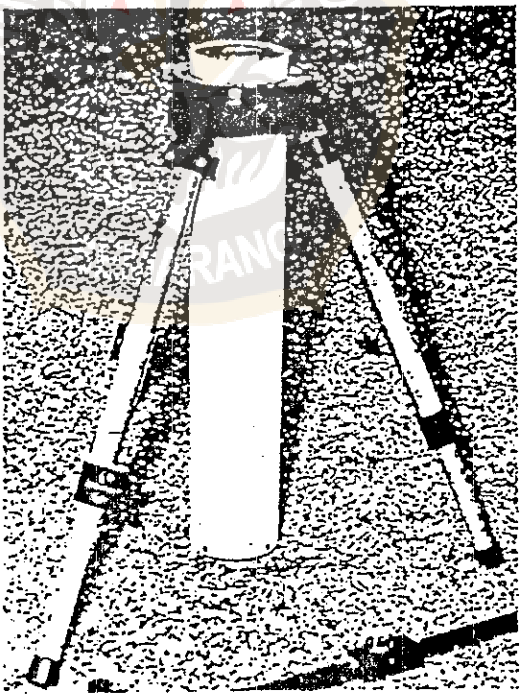
ANT/1
Magnetic Antenna



The ANT/1 antenna is a single channel magnetic field antenna used for controlled source audio-frequency magnetotelluric (CSAMT), and other types of frequency domain EM geophysical surveys measuring vertical or horizontal fields. Multiple units may be used simultaneously to measure multiple axes. The ANT/1 is provided with frequency domain calibration for both harmonic and single frequency applications.



Optional stand for vertical measurements — STAND/Z.

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Lampiran D – 4

SPECIFICATIONS: ANT/1 MAGNETIC ANTENNA

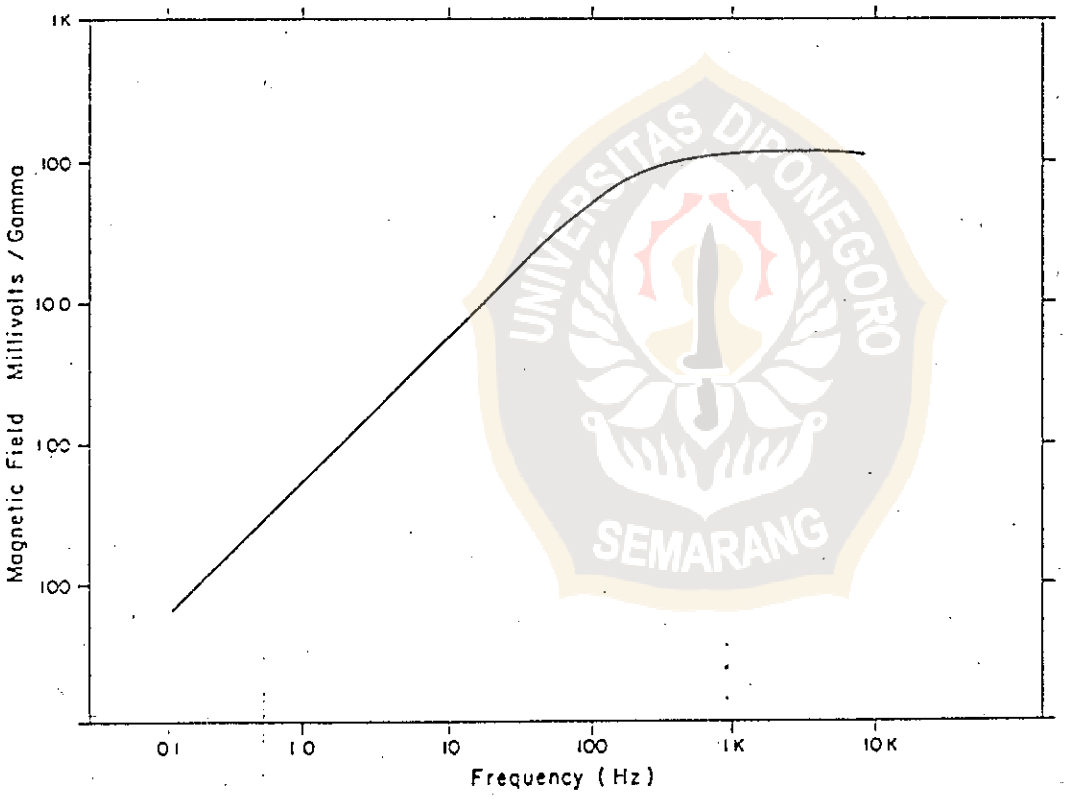
ıeral

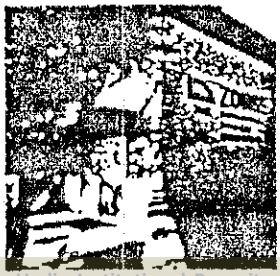
er: Two 9V alkaline batteries
ery life: 14 days at 12 hours per day
olifier gain: 101
ıber of turns: 8000
ctive Area: 82,000 m²
imum Detectable Signal:
04 gamma•Hz for dB/dt response
0016 gamma/Hz at 4 kHz
imum signal without saturation:
00 gamma•Hz for dB/dt response range
7 gammas at 4 kHz

Physical

Length: 80 cm
Diameter: 9.5 cm
Weight: 8.0 kg
Core: ceramic ferrite, 2.54 x 61 cm

Specifications subject to change without notice





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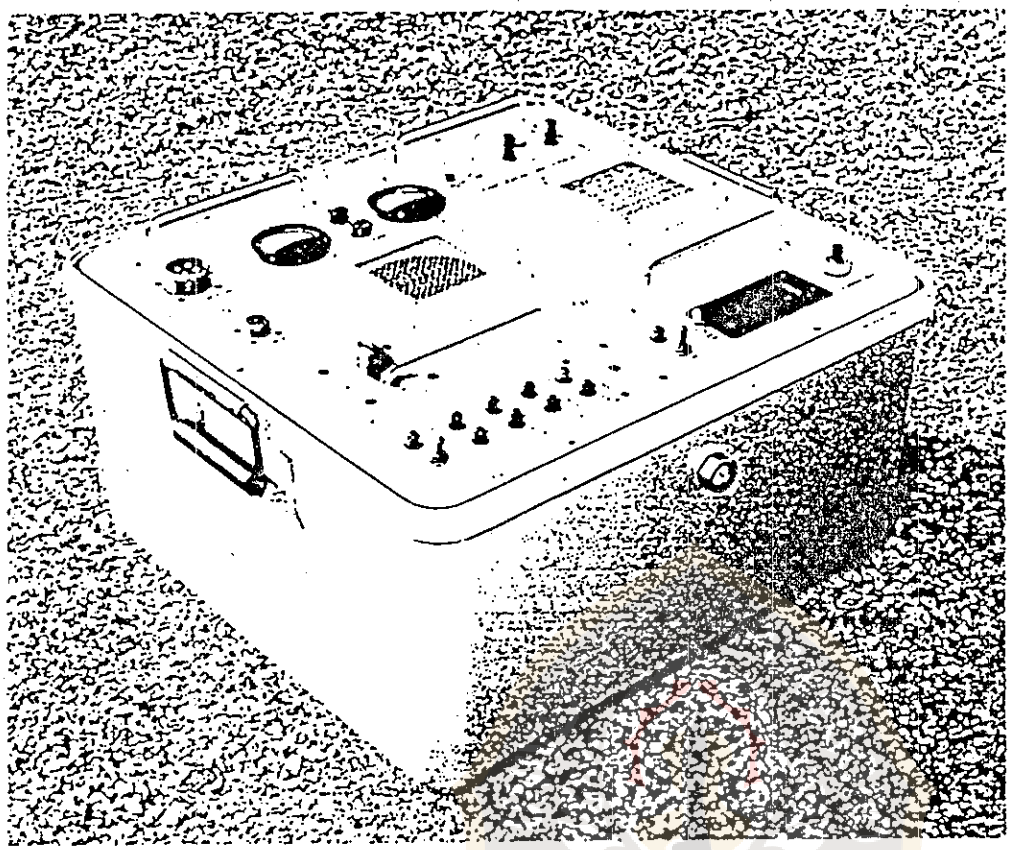
THE GGT-10 TRANSMITTER
Versatile, Medium-Power

ZONGE



FEATURES

- Constant current supply
- Used for time/frequency domain IP, Resistivity, CR, TEM, CSAMT
- Broad-band: DC to 8 kHz (standard)
- Outputs up to 1000 V, 30 A
- Fast turn-off time: 125 μsec (300 x 300 m loop)
- Drives a loop or grounded dipole
- Efficient, modular design for quick field repair
- Rugged design reliable in all climates
- Optional internal time base

SPECIFICATIONS FOR THE GGT-10 TRANSMITTER

eneral

scription: Broad-band, constant-current, time and requency domain, medium-power geophysical ransmitter
closure: Welded, hardened aluminum frame inserted in a high-impact fiberglass case
e: 53 x 51 x 37 cm (21 x 20 x 14.5 in)
eight: 51 kg (113 lb)
erating temperature: −40° to +55°C (−40° to +130°F)
erating humidity: 0 to 90%, non-condensing

ectrical Characteristics

ves a loop or ground dipole
n-off time: Under 10 μsec for a resistive load; 125 μsec for a 300 x 300 m loop (16 ohms resistance, full current)
aximum input: 10 KVA @ 30°C
tput voltage range: 50 to 1000 V
tput current range: 0.2 to 20 A
rrent stability: ±0.2%
equency range: DC to 8 kHz

witching Control

witching controlled by external device
ecommended transmitter controller: Zonge XMT-16
aveform type: Capable of virtually any type of pulse waveform, limited by external controller device

ntrols

wer ON/OFF
ansmit/reset switch
rrent adjust pot, continuously adjustable, locking
ltage range switch (50–250 V, 200–500 V, 450–750 V, 700–1000 V)
oop/dipole select switch

Displays

Analog input voltage meter, 0–150 V
Analog output voltage meter, 0–1000 V
Power on/off lamp, transmit lamp, output lamp
LCD: Output current (±0.01 A)
Input power (0–30 KW)
Transformer temperature
Loop turn-off time (microseconds)
Indicator lamps: control power on, transmit on, transmit polarity
Fault indicator lamps: output and input overcurrent, output and input overvoltage, end of regulation, alternator overvoltage, open circuit

Output Jacks

Current calibrate terminals (50 mV/A)
Output current terminals
Grounding jack

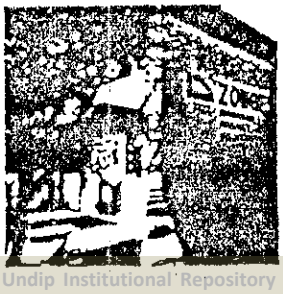
Power

Three-phase, 120 VAC, 400 Hz
Recommended motor/generator set: ZMG-7.5
Power connector: four-pin military screw-type with locking ring

Options

Spare parts kit (standard and extended kits available)
LCD heater for temperatures below −15°C (+5°F)
Current monitor ISO amp module
Resistor load bank
Switch box for rapid switching of dipole pairs
Internal timing board for specified IP-range frequencies
30 amp output

Specifications subject to change without notice



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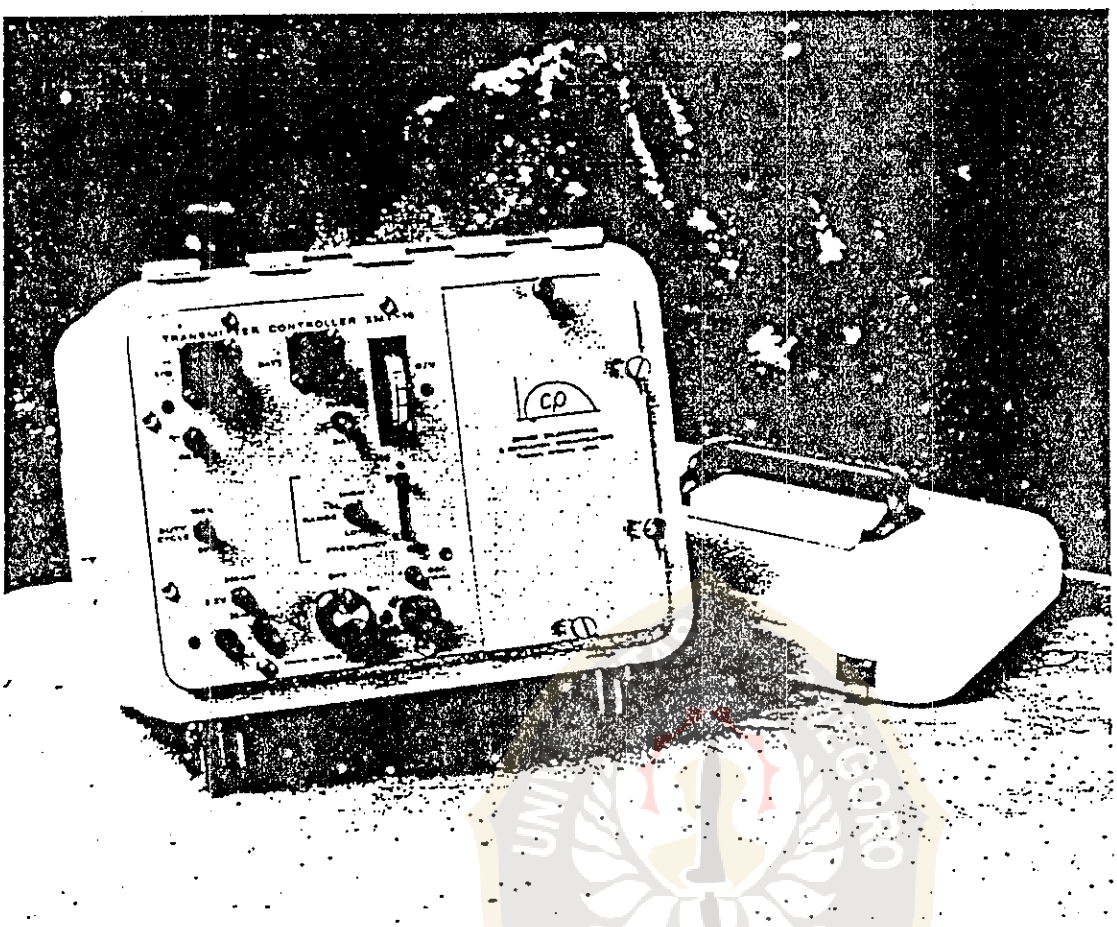
XMT-16
Transmitter Controller

ZONGE



FEATURES

- Time or frequency domain control
- Calibrator output
- Frequency range:
  1024 second period to 8192 Hz
- Compatible with all GGT-series and
  ZT-20 transmitters

SPECIFICATIONS FOR THE XMT-16 TRANSMITTER CONTROLLER

neral

chronous time-base with internal calibrator.
ie or Frequency domain capability, 50% or
00% Duty cycle.
quency range in Binary Steps:
High—0.25 to 8192 Hz
Low—1024 sec to 32 Hz
optional frequencies on request)
e: 28 x 21 x 18 cm (11 x 8 x 7 in)
ight: 6.4 kg (14 lb)
closure: Heavy duty, environmentally sealed
luminum case.
ver: 12 V rechargeable battery
nore than 10 hours continuous operation
nperature range: −20° to +60°C (−4° to 140°F)
midity range: 0 to 95% non-condensing
ie base: Oven-controlled crystal oscillator;
ging rate <5 x 10^{-10} per 24 hours
optional crystal: 1 x 10^{-11} per 24 hours.)

splays & Controls

ase / Battery meter
ie / Frequency switch
ttery / Phase meter switch
gh / Low range calibrate output switch
5 / .25 / 2.5V PP
set switch
quency range thumbwheel switch
cuit Breaker

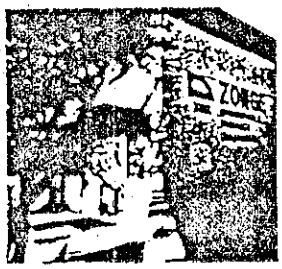
tputs & Inputs

/ Battery charge input
ntrol input/output
librate output

Functions

Can be synchonized with GDP-16 Receiver for synchronous measurements. Capable of controlling GGT series and ZT-20 transmitters in both time and frequency domain. Continous phase coherency between 1024 second period and 8192 Hz. 20 milliamp control signal outputs for transmitter. Reset pulse output for GDP series receiver.

Specifications subject to change without notice



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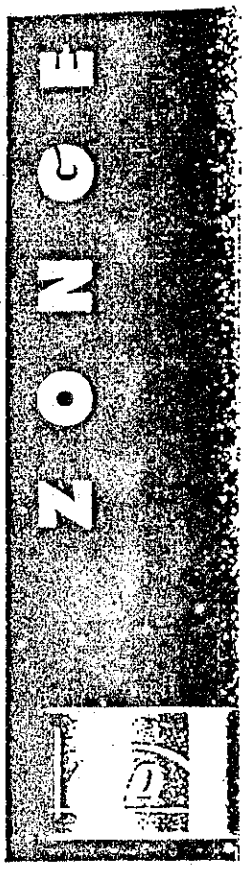
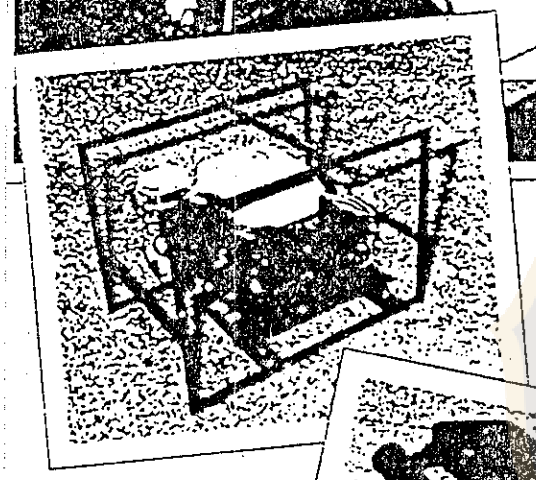
POWER SYSTEMS FOR GEOPHYSICAL TRANSMITTERS

RUGGED, CUSTOM-DESIGNED MOTOR/GENERATOR SETS

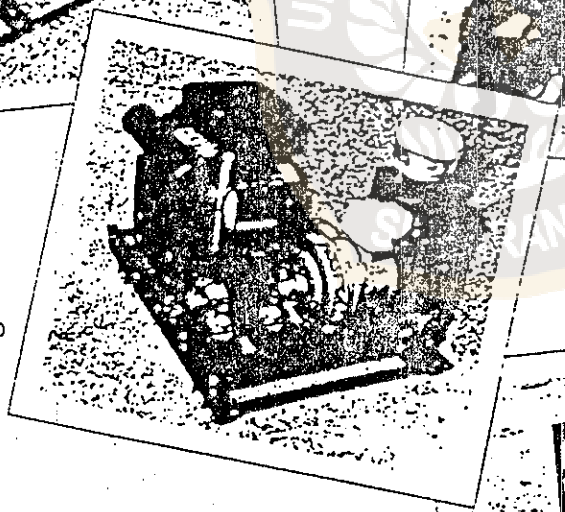




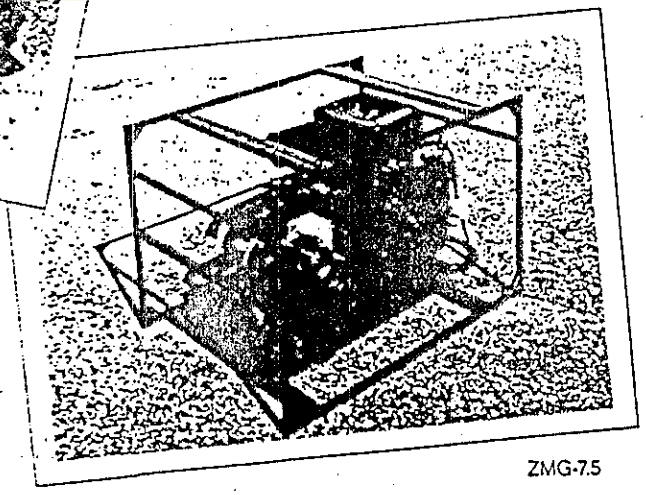
ZMG-3

ZMG-30

BMG-3



ZMG-10



ZMG-7.5

FEATURES

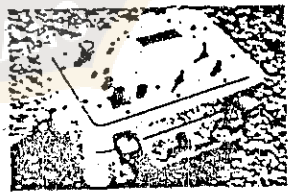
- Five power systems from portable 3 kW to trailer-mounted 30 kW
- Exceptionally rugged and field-proven
- Power systems drive Zonge Engineering and other transmitters

Zonge Engineering and Research Organization, Inc.
Specialists in Electrical Geophysics • Field Surveys • Geophysical Consulting • Instrumentation Sales and Lease

SPECIFICATIONS FOR THE MOTOR/GENERATOR SETS

	BMG-3	ZMG-3	ZMG-7.5	ZMG-10	ZMG-30
Engine					
Cyl/cycle	1/4	1/4	2/4	2/4	4/4
Power (hp @ rpm)	5 @ 3600	8 @ 3600	18 @ 3600	22 @ 3150	62 @ 2400
Fuel	Regular/unleaded				
Starter	Manual	Manual	Electric	Electric	Electric
Alternator					
Output (kva)	2.5	2.5	9	32	32
Type	120/208 VAC/400 Hz/3-phase				
Base Frame					
Construction	Aluminum	Aluminum	Aluminum	Steel	Steel
Size (cm)[1]	19x34	36x46	46x79[2]	69x94	91x137
Assembled Unit					
Power (kva)	2.5	2.5	7.5	10	30
Size (cm)[1]	36x46x71	51x71x51	46x79x56[2]	69x94x74	91x142x79
(in)[1]	14x18x28	20x28x20	18x31x22[2]	27x37x29	36x56x31
Weight (kg)	36	52	107	204	432
(lb)	78	114	235	450	950
Ship. Wt. (kg)	68	82	162	264	500
(lb)	150	180	355	580	1100
Fuel Supply	Internal	Internal	External	External	External
Power Cable	Included	Included	Included	Included	Included
Voltage Regulator	Included	Included	Included	Included	Included
Trailer-mounted ZMG sets					
Size (m)[1]	-	-	-	1.8x3.2x1.5	1.8x3.2x1.8
(ft)[1]	-	-	-	5.9x10.5x5.0	5.9x10.5x5.9
Wt. w/full tanks (kg)	-	-	-	794	998
(lb)	-	-	-	1750	2200
Options	Spare parts	Spare parts	Spare parts	Spare parts	Spare parts

1 All sizes specified in width x length x height
2 Mounted in a skid measuring 74x94x66 cm (29x37x26 in)



Zonge VR-1
Voltage Regulator
included with all
Motor/Generators

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